STRUCTURE OF MICROCARD

A01/1 = Structure of microcard

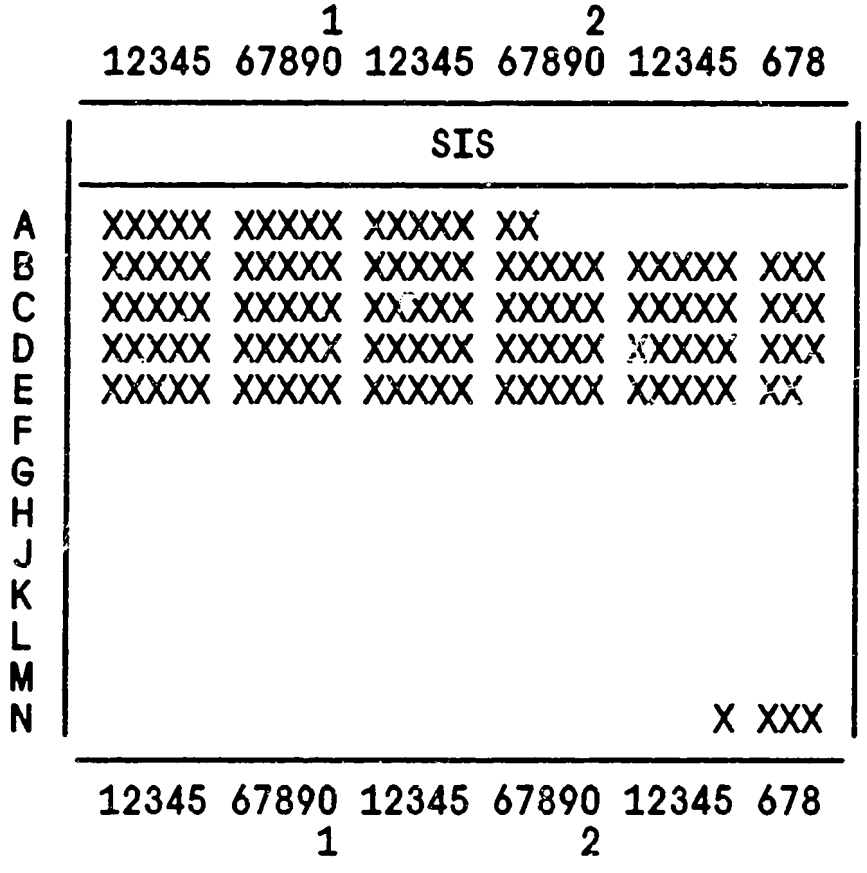
A03/1 = Special features, general instructions, safety measures, testers, devices and tools

B01/1 = Repair, testing

N27/1 = Table of contents

N28/1 = Editorial note

Continue: A02/1 Fig.: A01/2



Continue: A02/1

DESCRIPTION OF TROUBLE-SHOOTING INSTRUCTIONS

User prompting is provided on every page e.g.:

- Continue: B17/1
- Continue: B18/1 Fig.: B17/2
- Yes: B18/1 No: B15/1
- Yes: B17/1 No: B16/1 Fig.: B15/2

.../1 = upper coordinate half
.../2 = lower coordinate half

Continue: A01/1

SPECIAL FEATURES

These instructions give a detailed description of repair, testing and adjustment of the

RE GOVERNOR POSITIONERS RE 24 AND RE 30

as used on size "P" in-line pumps.

The RE positioner is part of the EDC (Electronic Diesel Control) system for heavy commercial vehicles. It is attached directly to the corresponding fuel-injection pump instead of the otherwise standard mechanical governor and forms an injection-pump assembly together with the pump.

Continue: A03/2

SPECIAL FEATURES

Refer to Service Info (see SIS list KFZ 00.. / NKW 000) for detailed description of EDC system as a whole and of RE positioner.

Assignment of positioners to fuel-injection pumps:

RE 24: Series	PE(S)..P..S 3000
RE 30: Series	PE(S)..P..S 7100
	PE(S)..P..S 8000
	PE(S)..P..S 8500

Continue: A04/1

GENERAL

The two positioners RE 24 and RE 30 are basically identical. Differences are merely to be found in terms of the positioner housing on account of the differing installation conditions on the respective injection-pump series.

The version of the RE 30 positioner intended for use on fuel-injection pumps with no ELAB features a mechanical stop lever for emergency shutoff, whereas this is not provided on the version for pumps with ELAB.

Continue: A04/2

GENERAL

Special positioner versions for various vehicle manufacturers have cable lead-throughs with overhung plug for the electrical-system connection instead of the housing-fixed round screw connection.
When testing these versions on an injection-pump test bench, it should be noted that appropriate adapter leads are needed for attachment of the tester.
Further positioner modifications introduced during series production are dealt with in the appropriate sections.

Continue: A05/1

GENERAL

The repair and testing of RE positioners was grouped together in these instructions since the scope of repair work on the positioner itself is not particularly extensive and since various operations linked to positioner assembly are performed on the injection-pump test bench.

Continue: A05/2

GENERAL

Generally speaking, complete disassembly of the positioner, i.e. removal of the positioner housing, is only necessary if the fuel-injection pump has to be repaired. In this respect, there are no special features as opposed to versions with mechanical governor (e.g. setting of camshaft projection with series ..S 3000).

Continue: A06/1

GENERAL

As regards repairs to fuel-injection pumps with RE positioner, reference is made to the existing repair instructions for the appropriate series. Attention should be paid to the following differences:

* The control-rod guide bushing is pressed in on the pump drive end and secured by way of a bonded-in threaded bush. A positioning pin stops the bush turning.
  The guide bush cannot be removed using normal workshop equipment, i.e. the housing has to be replaced if worn.

Continue: A06/2

GENERAL

* The control rod forms a unit with the governor-end bush (with crimped-in seal ring), return spring, plate washer with riveted-on shorting ring of rack position sensor and cap nut. In the event of a defect (control-rod wear, damage to shorting ring) the entire unit has to be replaced. Control-rod disassembly and assembly on the positioner end involve screwing out/screwing in the bush.

Continue: A07/1

GENERAL

* The return force of the control-rod return spring is far greater than that of the play-compensating spring on pumps with mechanical governor. In order to be able to sensitively check the freedom of movement of the control rod at all times during assembly of the pump, it should be completely pretensioned with the aid of the spring tensioner 0 986 612 311 (KDEP 1704) and thus made ineffective.

* The camshaft chamber of the fuel-injection pump should only be checked for leaks with the positioner fitted and tightly sealed.

Continue: A07/2

GENERAL INSTRUCTIONS

When repairing a positioner, worn, damaged and electrically defective components are always to be renewed.

The servo magnet, rack position sensor, speed pulse generator and plug plate with 7-pole pin terminal are installed in the positioner cover and can be replaced individually.

Continue: A08/1

GENERAL INSTRUCTIONS

All individual parts are supplied as service parts in corrosion-proof packaging and must be stored in this packaging until ready for use. This applies above all to the servo magnet.

Complete positioners are supplied in packaging which is resistant to impact, breakage and corrosion, and are likewise to be stored in the original packaging.

Re-useable/new positioner covers are to be handled with extreme care and whilst maintaining upmost cleanliness.

Continue: A08/2

GENERAL

Reusable parts, which are to be stored for a lengthy period, should be covered and protected against dirt and rust.

When assembling positioner, always renew all seals and seal rings. This also applies to the radial-lip-type oil seal if the positioner housing has been disassembled.

Continue: A09/1

SAFETY MEASURES

Component cleaning: Wash out in commercially available cleaning agent such as Chlorothene NU, which is not readily flammable, and blow out with compressed air.

Skin protection: In order to avoid the possibility of skin irritation when handling calibrating oil, oils and greases, apply hand cream before starting work and wash hands in soap and water when finished.

Continue: A09/2

SAFETY MEASURES

Safety precautions for handling flammable liquids:

* In Germany:
  Order Governing Work with Flammable Liquids (VBF) as issued by the Federal Ministry of Labor (BmA).
  Safety regulations for handling chlorinated hydrocarbons:
  - companies: ZH 1/222
  - employees: ZH 1/129
  as published by the Hauptverband für gewerbliche Berufsgenossenschaften (Zentralverband für Unfallschutz und Arbeitsmedizin),
  Langwardweg 103, 55129 Bonn.

Continue: A10/1

SAFETY MEASURES

Safety regulations when handling flammable liquids (continued):

* In all other countries:

  In all other countries the local regulations are to be observed.

Continue: A10/2

SAFETY MEASURES

When repairing and testing injection pump/positioner make exclusive use of the special tools and testers listed in these instructions/in the product-related instructions.

If use is made of incorrect/unsuitable tools and testers, there is a danger of injury/damage to products and component parts.

Continue: N27/1

TESTERS, DEVICES AND TOOLS

The testers, devices and tools required for RE positioners are listed.

The standard devices and tools specifically required for P-pumps and commercially available tools are not listed.

The special test equipment for test-bench testing for each injection-pump combination is indicated on the specific test-specification sheet.

Continue: A12/1

TESTERS, DEVICES AND TOOLS

* Test control unit (universal evaluation circuit) for testing and adjusting rack position sensor	0 986 610 101 KDEP-P 400/1
* Universal test lead (connection of test control unit in conjunction with following version-specific adapter leads)	0 986 610 102 KDEP-P 400/2

Continue: A12/2

TESTERS, DEVICES AND TOOLS

* Adapter leads for version-specific positioner connection	
- Housing-fixed round screw connection	0 986 610 104 KDEP-P 400/3
- Cable outlet with overhung Schlemmer plug (MAN)	0 986 610 107 KDEP-P 400/6
Cable outlet with overhung Deutsch plug (Mack)	0 986 610 109 KDEP-P 400/7

Continue: A13/1

TESTERS, DEVICES AND TOOLS

* Regulator 12 V/15 A comm. avail.
  (adjustable current output)
  for actuation of servo-magnet

* Regulator 12 V/3 A comm. avail.
  for power supply,
  test control unit and ELAB

* Voltmeter comm. avail.
  (digital multimeter)
  Requirements: Basic accuracy DC:
  - less than 0.1 % of reading
  - resolution 0.001 V in range
    up to approx. 4 V

Continue: A13/2

TESTERS, DEVICES AND TOOLS

* Adjustment gauge for speed pulse generator	0 986 612 301 KDEP 1701
* Setting gauge for checking position of rack-position-sensor shorting ring	0 986 612 308 KDEP 1703
* Assembly device for positioning and blocking speed-sensor pulse wheel (Note reworking instructions at end of this section)	0 986 612 305 KDEP 1702

Continue: A14/1

TESTERS, DEVICES AND TOOLS

* Camshaft blocking device for assembling speed-sensor pulse wheel (blocking at drive coupling)	0 986 612 056 KDEP 1545
* Compensating ring for KDEP 1545 for couplings with 30 mm taper	0 986 612 356 KDEP 1737
* Compensating ring for couplings with 35 mm taper	0 986 612 254 KDEP 1630

Continue: A14/2

TESTERS, DEVICES AND TOOLS

* Puller for speed-sensor pulse wheel	0 986 618 245 KDMZ 6999
* Spring collet 16.8 mm for disassembling closing cap of rack-position-sensor fastening screw (Note reworking instructions at end of this section)	0 986 619 225 KDAW 9995/3
* Threaded pin with clamping pin. Used in conjunction with KDAW 9995/3.	0 986 619 250 KDAW 9995/14

Continue: A15/1

TESTERS, DEVICES AND TOOLS

Note: The two previously mentioned items form part of the collet set KDAW 9995 (0 986 619 213)/tool board KDAW-T 100 (0 986 619 010).

* Support tube for use in conjunction with the two previously mentioned items	User manufacture
Approx. dimensions:	
ID	22 mm
OD	27 mm
Length	190 mm

Continue: A15/2

TESTERS, DEVICES AND TOOLS

* Pin-type socket wrench for counter-holding plastic seal for rack-position sensor when drilling out (plastic seal in newer positioners instead of steel closure cap)	0 986 611 459 KDEP 2990
* Guide pin (set = 2 x) for installing cover on positioner housing	0 986 612 598 KDEP 1910

Continue: A16/1

TESTERS, DEVICES AND TOOLS

* Stand for dial indicator, for checking eccentricity of pulse wheel	4 851 601 124
* Dial indicator, scale divisions 0.01 mm	1 687 233 011 or comm. avail.
* Offset base for dial indicator, offset approx. 10 mm	comm. avail.
or (thread M 2.6)	0 986 611 546 KDEP 1023/0/6
with lock nut	0 986 611 547 KDEP 1023/0/7

Continue: A16/2

TESTERS, DEVICES AND TOOLS

* Start-of-delivery blocking device for positioning pulse wheel	0 986 611 746 KDEP 1077
* CRT measuring device	1 688 130 130
* Accessory set for P-pumps for 1 688 130 130	1 687 000 053
* Threaded sleeve (female thread) for attaching CRT measuring device (special accessory for 1 688 130 130)	1 683 315 022

Continue: A17/1

TESTERS, DEVICES AND TOOLS

* Oscilloscope for testing speed-sensor signal	comm. available or Bosch: MOT 300/301 with MOT 400/401 via special input
* Vacuum gauge for testing oil pump	comm. available or Bosch: 1 688 130 032
* Prestroke measuring device for P-Pumps	1 688 130 112
* with dial indicator (30 mm, scale divisions 0.01 mm)	1 687 233 012

Continue: A17/2

TESTERS, DEVICES AND TOOLS

Illuminated magnifier min. 6x magnification	comm. avail. or Bosch 1 987 600 005
or Workshop microscope, 10x magnification	comm. avail.

For visual assessment of crimps on 7-pin terminal board in positioner.

Continue: A18/1

TESTERS, DEVICES AND TOOLS

* Soldering iron
  for soldering and
  unsoldering leads on
  7-pole connection
  plate commercially available

Requirements:
- Temperature regulation
- Soldering tip temperature
  350...370 degrees C
- Power approx. 50 W

Recommendation:
- Weller soldering station
  WTCP-S with
- soldering iron TCP-S 24 V, 50 W
- Soldering tip No. 7,
  Long, tapered, 370 degrees C

Continue: A18/2

TESTERS, DEVICES AND TOOLS

* Soldering tin:
  With no bismuth or cadmium
  content.

  Recommended soldering tin:
  DIN Sn60 Pb Cu2 or Sn63 Pb.

  Recommended flux:
  IN F-SW 26 (2.5%) or
  in USA: Type RMA 2...3% QQ-S-571

Continue: A19/1

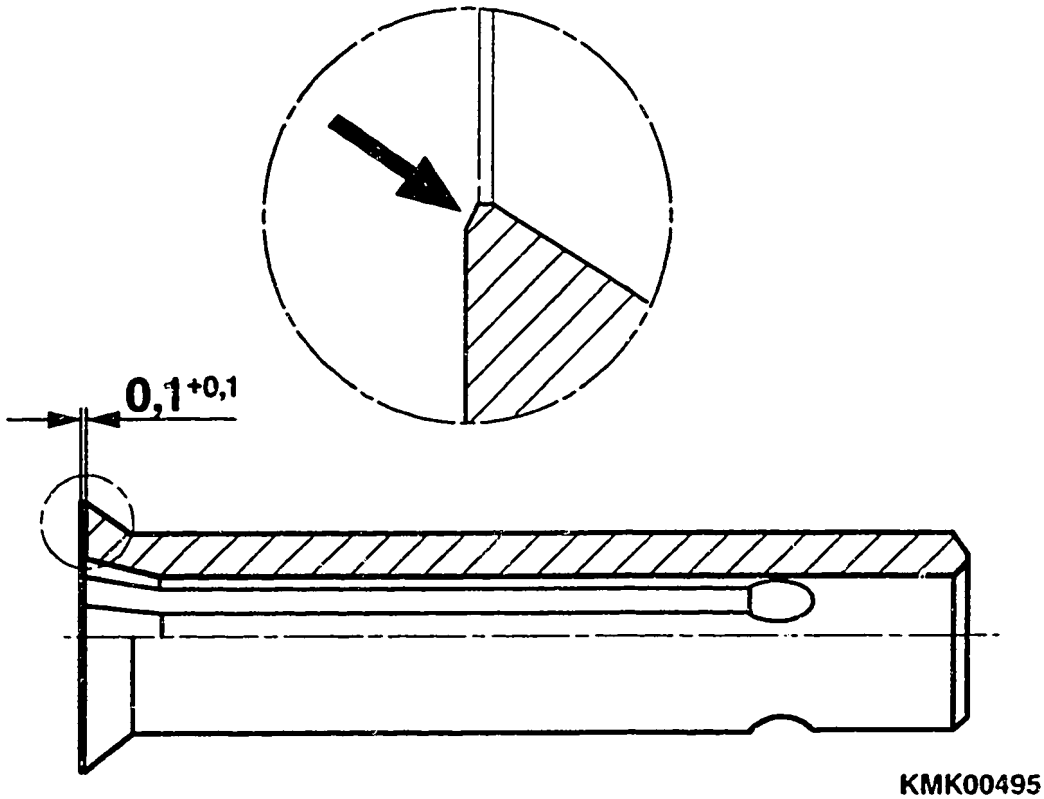
TESTERS, DEVICES AND TOOLS

Reworking instructions for spring collet 0 986 619 225 (KDAW 9995/3):

There are a few spring collets in circulation where the gripping edge is not sharp, with the result that the collets slip off when pulling out the closure cap.

Such collets are to be ground and chamfered on the end faces in the area of the gripping edge to produce an approx. 0.1 mm gripping edge (illustration).

Continue: A20/1 Fig.: A19/2



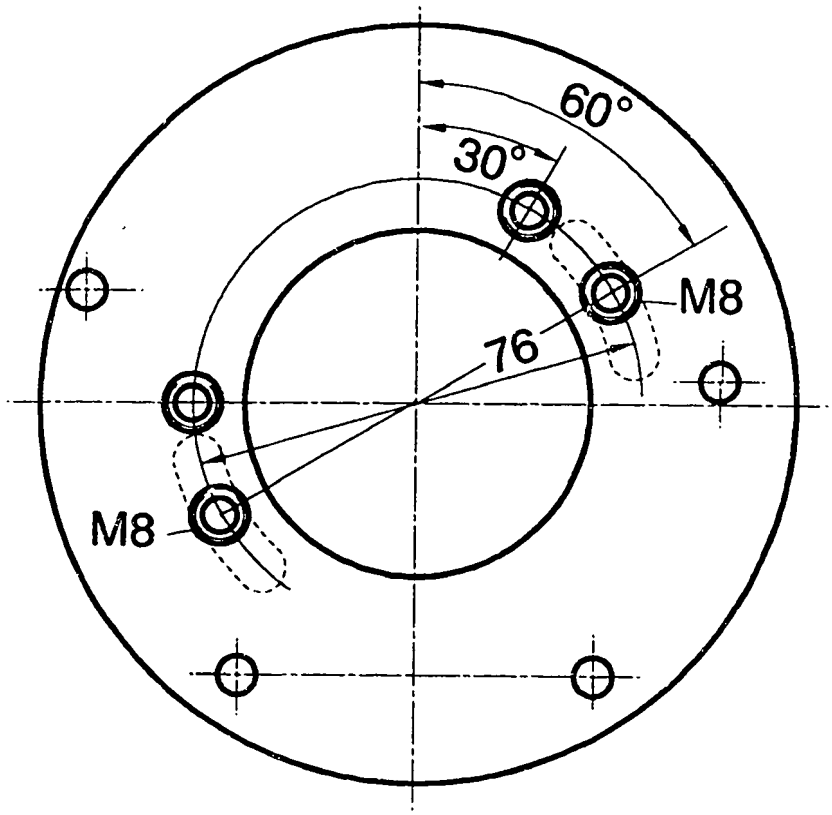
TESTERS, DEVICES AND TOOLS

Reworking instructions for assembly device 0 986 612 305 (KDEP 1702), delivered up to end of 1990:

Re retaining plate for above device:
For use on positioner RE 30 with start-of-delivery sliding flange make two additional tapped holes M 8 as shown in drawing.

Devices supplied as of the start of 1991 are in line with the state of the art and do not need to be reworked.

Continue: N27/1 Fig.: A20/2



KMK01006

TEST SPECIFICATIONS

There is a test-specification sheet, which is to be determined according to combination number and table of contents, for every injection-pump assembly with RE positioner. This test-specification sheet contains all the necessary test specifications and settings.

These repair instructions therefore only encompass generally valid values which are the same for all positioners.

Continue: A22/1

TEST SPECIFICATIONS

General test specifications:

Positioner with housing-fixed round plug connection:

Resistance measurements at positioner, pin:

1-6 (RPS-coil 1)	17...23 Ohm
6-5 (RPS-coil 2)	17...23 Ohm
1-5 (RPS total)	34...46 Ohm
2-7 (Servo-magnet)	0.55...0.90 Ohm
3-4 (Speed sensor)	900...1200 Ohm

Continue: A22/2

TEST SPECIFICATIONS

General test specifications:

Positioner with cable bushing and overhung Schlemmer plug:

Resistance measurements at plug, pin:

1-6 (RPS-coil 1)	17...23 Ohm
5-6 (RPS-coil 2)	17...23 Ohm
1-5 (RPS total)	34...46 Ohm
7-8 (Servo-magnet)	0.55...0.90 Ohm
3-4 (Speed sensor)	900...1200 Ohm

2 - not used

Continue: A23/1

TEST SPECIFICATIONS

General test specifications:

Positioner with cable bushing and
overnung Deutsch plug:

Resistance measurement at plug, pin:

A–F (RPS–coil 1)	17...23 Ohm
E–F (RPS–coil 2)	17...23 Ohm
A–E (RPS total)	34...46 Ohm
B–G (Servo–magnet)	0.55...0.90 Ohm
C–D (Speed sensor)	900...1200 Ohm

H – not used
J – not used

Continue: A23/2

TEST SPECIFICATIONS

General test specifications:

Maximum permissible eccentricity
of speed–sensor pulse wheel
measured at inside diameter:
From impeller to impeller: max. 0.03 mm
Over one revolution: max. 0.10 mm

Continue: A24/1

TEST SPECIFICATIONS

General test specifications:

Dimension "X" (thrust pin of servo-magnet armature): 0.1...0.3 mm

Dimension "Y" (distance between start-of-delivery cam and adjusting flange): Refer to test-specification sheet

Fuel-temperature sensor
(if provided)
Resistance value at calibrating-oil temperature
38...42 degrees C: 950...1400 ohms

Continue: A24/2

TEST SPECIFICATIONS

General test specifications:

Oil-pump functional test:

* Oil fill:	as far as overflow, however max. 100 ccm
* Speed:	1000 1/min
* Standard voltage (U/act): (control rod in shutoff position)	0...1 V
* Measurement time:	30 sec.
* Desired vacuum:	> 25 mbar

Continue: A25/1

TEST SPECIFICATIONS

General test specifications:

ELAB internal resistance:

12 V:	9.8...11.4 ohms
24 V:	42.0...48.0 ohms

ELAB functional test:

* Speed:	1000 min-1
* Standard voltage (U/Stan.):	3.100 V
* Measurement time following ELAB current cutout:	10 sec.
* Delivery after measurement time:	zero delivery

Continue: N27/1

ADHESIVES AND LUBRICANTS,
MATERIAL DESIGNATION

* Locking compound for positioner and component fastening screws		Loctite 242 (blue, bottle red)
* Hot bearing grease for radial-lip-type oil seal		
etc. Tube 45 ml	5 700 002 005	
Tube 225 ml	5 700 002 025	
* Engine oil for positioner		SAE 20 W 20
First fill:		100 cm3
* Molycote grease for clamping screw of rack position sensor.		
Molycote M55 Plus	5 903 060 000	

Continue: N27/1

TIGHTENING TORQUES

Positioner – pump housing (8 screws):	7...9 Nm
Cover – positioner housing (8 screws):	7...9 Nm
Speed pulse generator flange (3 screws):	9...11 Nm
Generator (2 bolts, nuts):	8...10 Nm

Continue: A27/2

TIGHTENING TORQUES

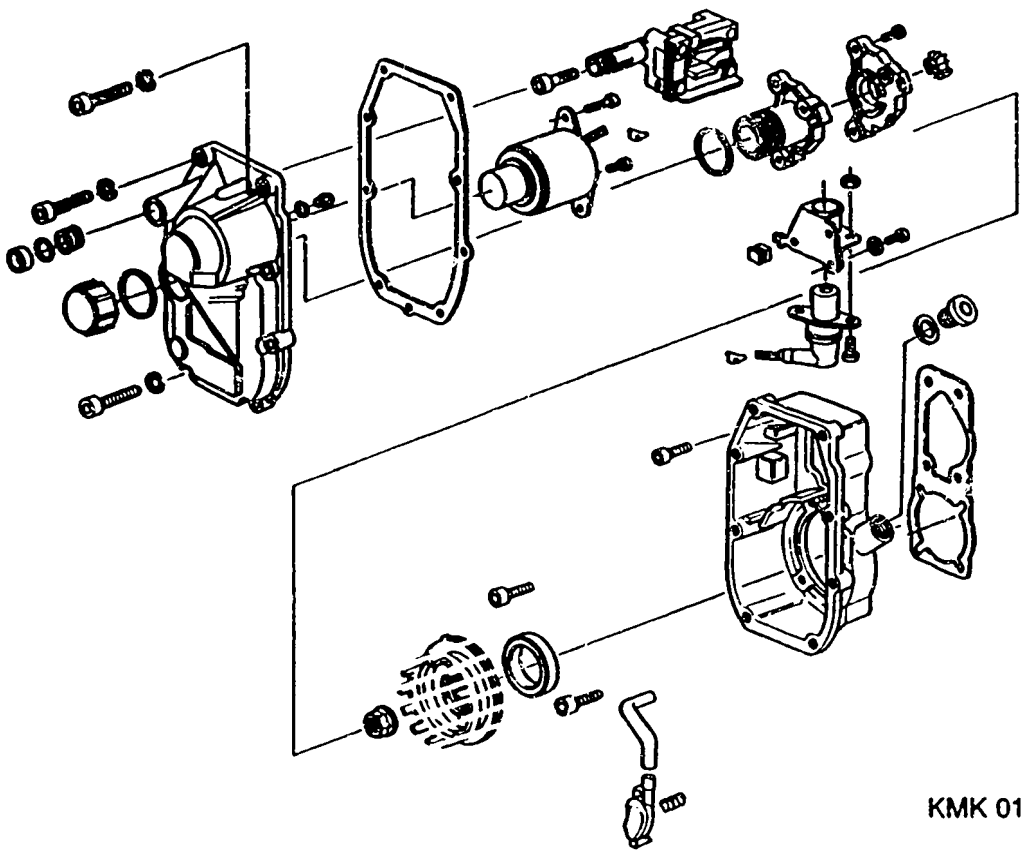
Servo-magnet backing plate (2 screws):	9...11 Nm
7-pole positioner plug plate (3 screws):	9...11 Nm
Tensioning screw for rack position sensor (tighten quickly and smoothly):	15...18 Nm
Fastening nut Pulse wheel to camshaft (taper 17 mm):	80...90 Nm
(taper 20 mm):	90...100 Nm

Continue: N27/1

INDIVIDUAL COMPONENTS OF POSITIONER RE 24

The picture illustrates the individual components and their location in the RE 24 positioner.

Continue: B02/1 Fig.: B01/2

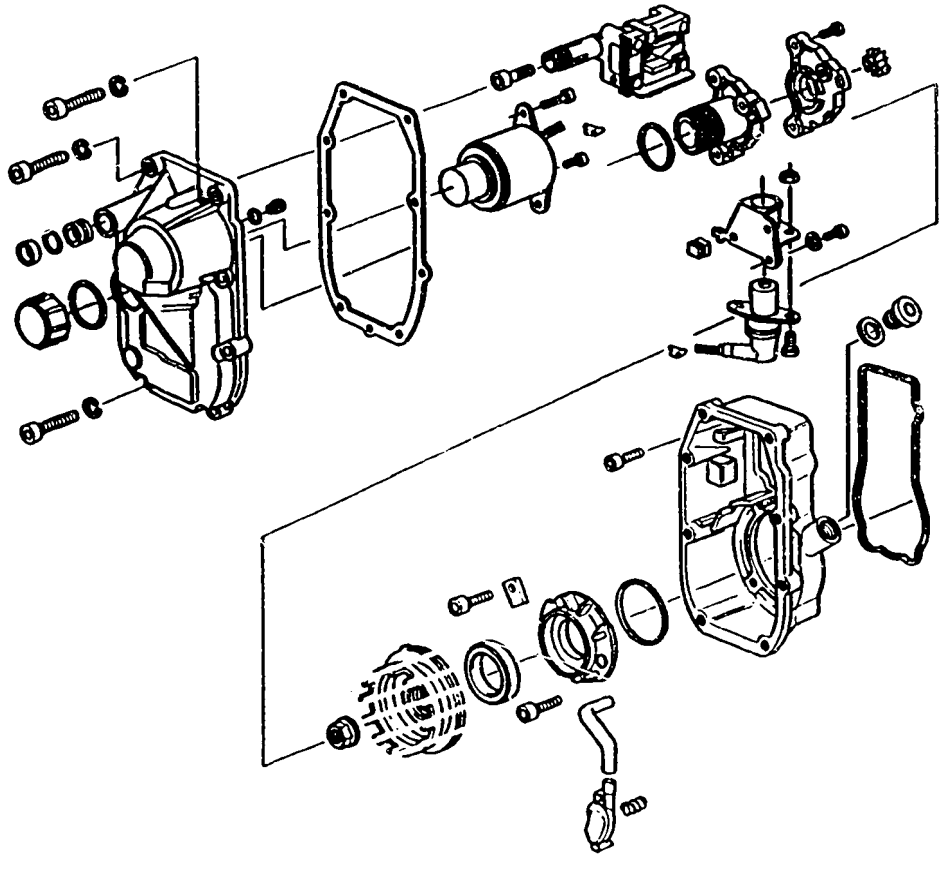


KMK 01007

INDIVIDUAL COMPONENTS OF POSITIONER RE 30 WITH NO STOP LEVER

The picture illustrates the individual components and their location in the RE 30 positioner (version with no stop lever).

Continue: B03/1 Fig.: B02/2

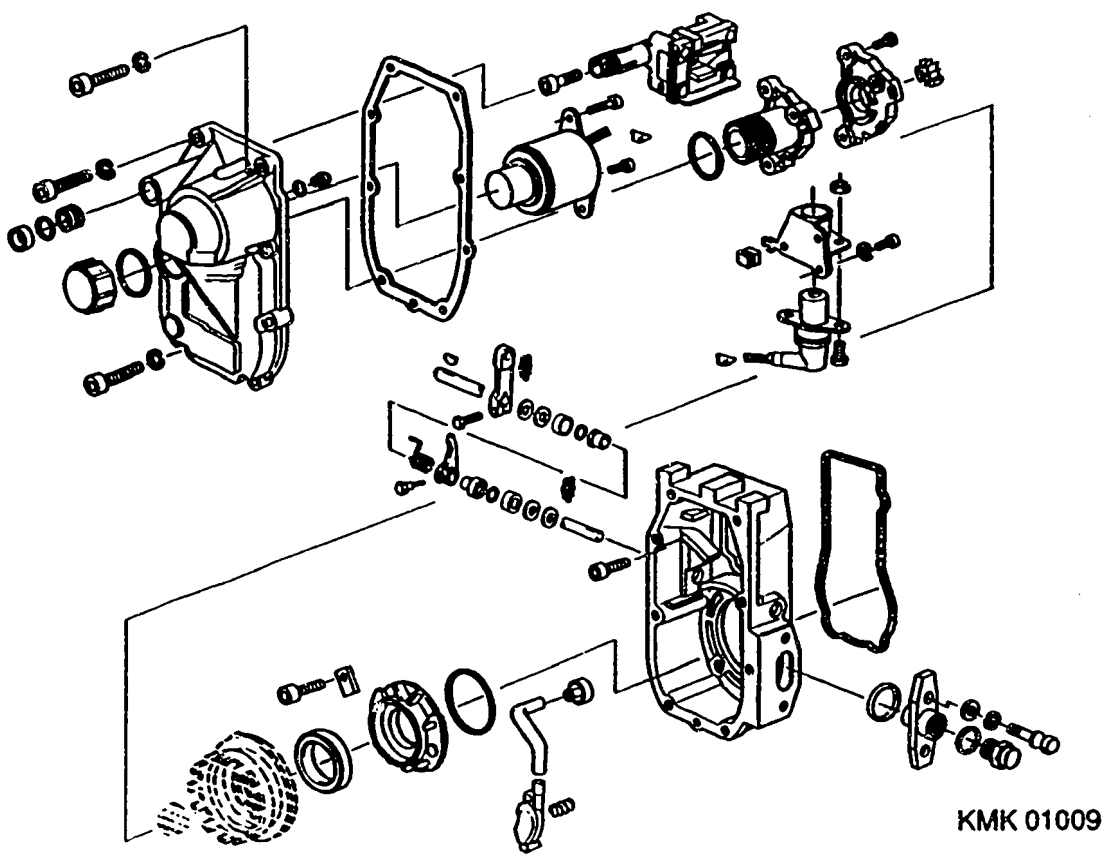


KMK 01008

INDIVIDUAL COMPONENTS OF POSITIONER RE 30 WITH STOP LEVER

The picture illustrates the individual components and their location in the RE 30 positioner (version with stop lever).

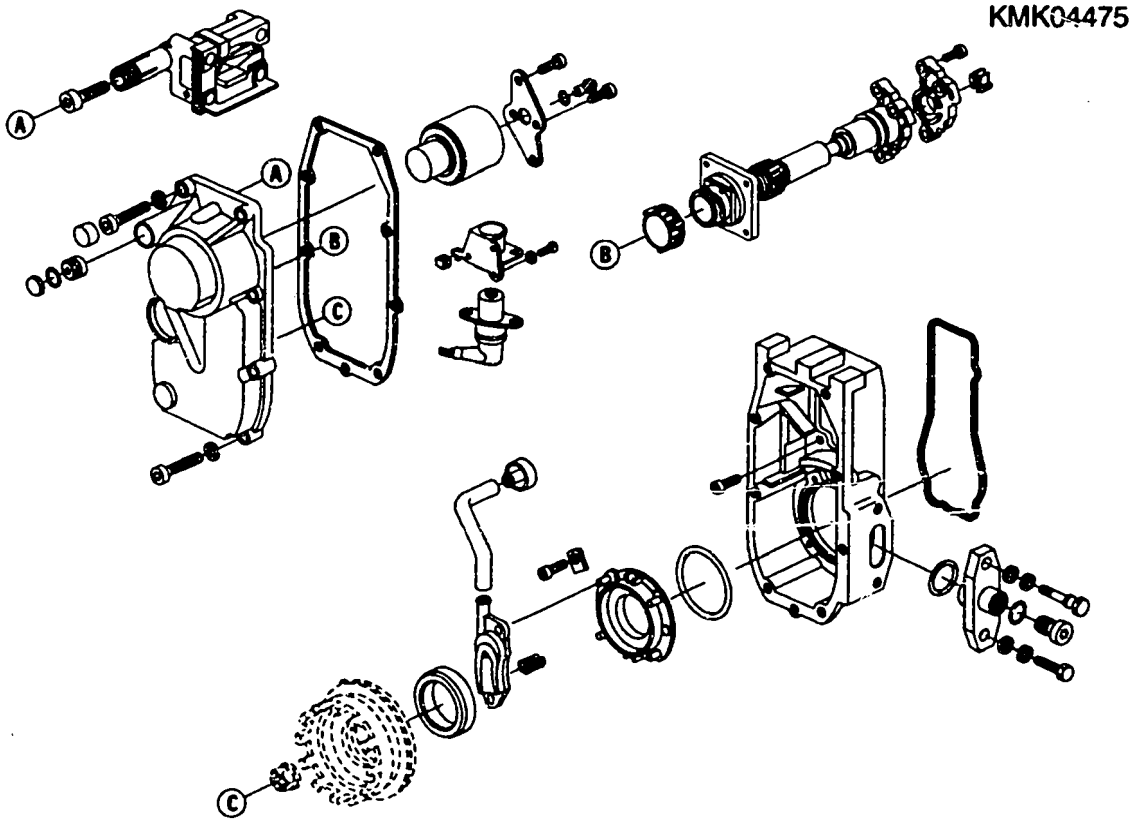
Continue: B04/1 Fig.: B03/2



INDIVIDUAL COMPONENTS OF POSITIONER WITH CABLE BUSHING

Positioner with cable bushing and vehicle-specific connector instead of housing-fixed round screw connection (example: Schlemmer).

Continue: N27/2 Fig.: B04/2



POSITIONER DISASSEMBLY

Assembly work on the positioner is not particularly extensive. Depending on the complaint received, only partial disassembly is required, and this can be performed on the fuel-injection pump whilst it is mounted on a test bench. Certain operations, for example assembly of the speed-sensor pulse wheel, must be carried out on a test bench. Complete disassembly of the positioner including housing removal is generally only required in the event of pump repair.

Continue: B06/1

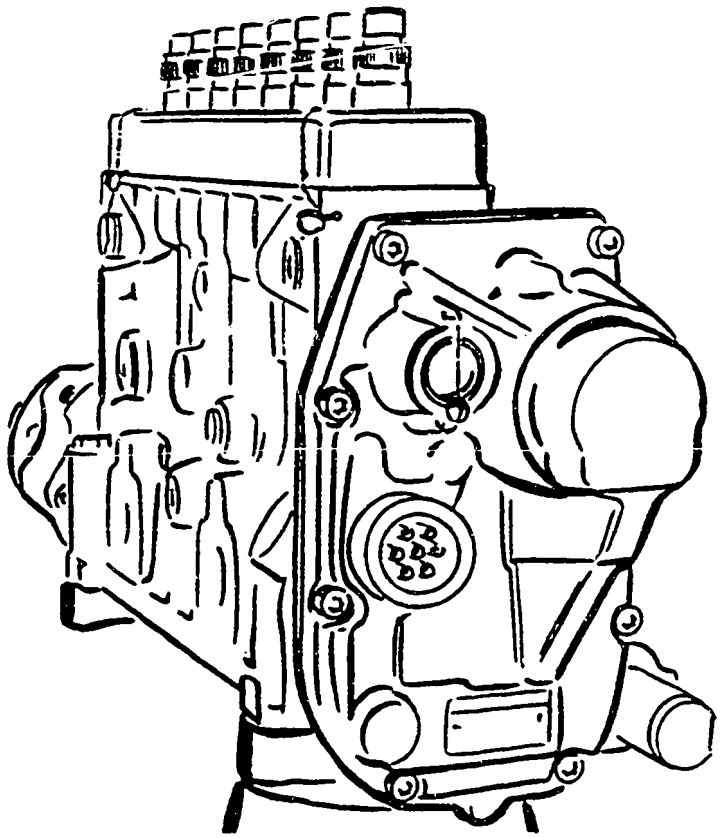
DISASSEMBLING POSITIONER

Complete disassembly of positioner.

Mount injection pump on rotatable assembly frame 0 986 611 248 (KDEP 2919)/on injection-pump test bench.

Remove sealing wires/plastic seals of positioner fastening screws.
Note: It is advisable to memorize the different plastic seal assembly locations for the different positioners.

Continue: B07/1 Fig.: B06/2

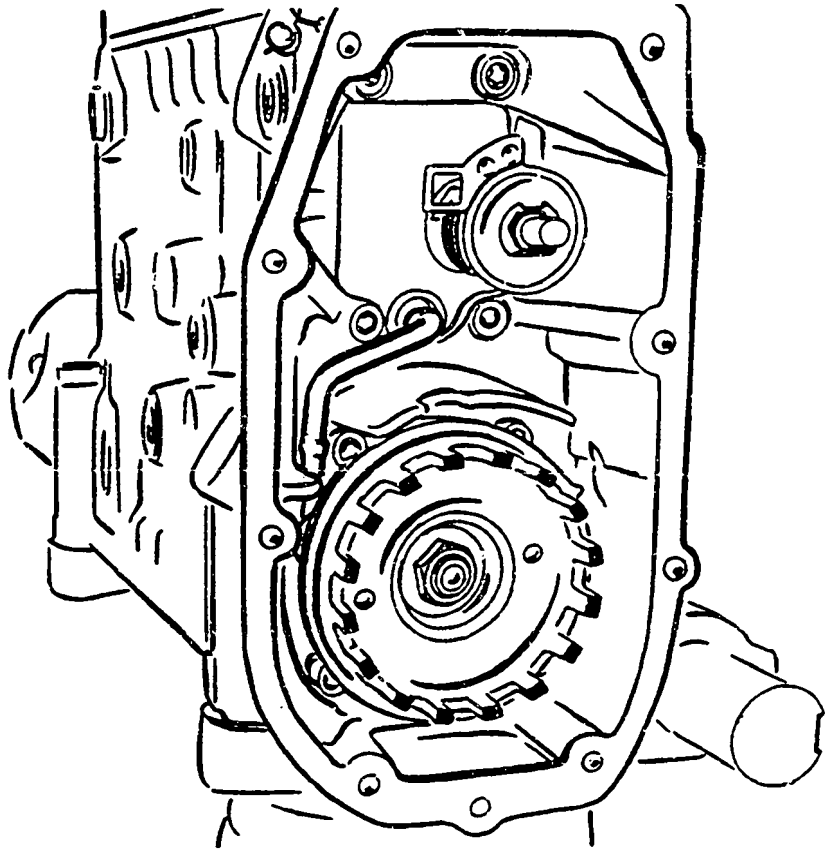


KMK 01010

DISASSEMBLING POSITIONER

Screw out two fastening screws of positioner cover at magnet level and screw in guide pins 0 986 612 598 (KDEP 1910).
Screw out remaining screws and take off complete positioner cover via guide pins in axial direction. Catch residual oil.
Proceed with caution so as not to damage measurement arm and shorting ring of rack position sensor and speed sensor.
Note: If repair work is only to be performed on positioner cover: Continue with section "REPAIRING POSITIONER COVER": C12/1

Continue: B08/1 Fig.: B07/2

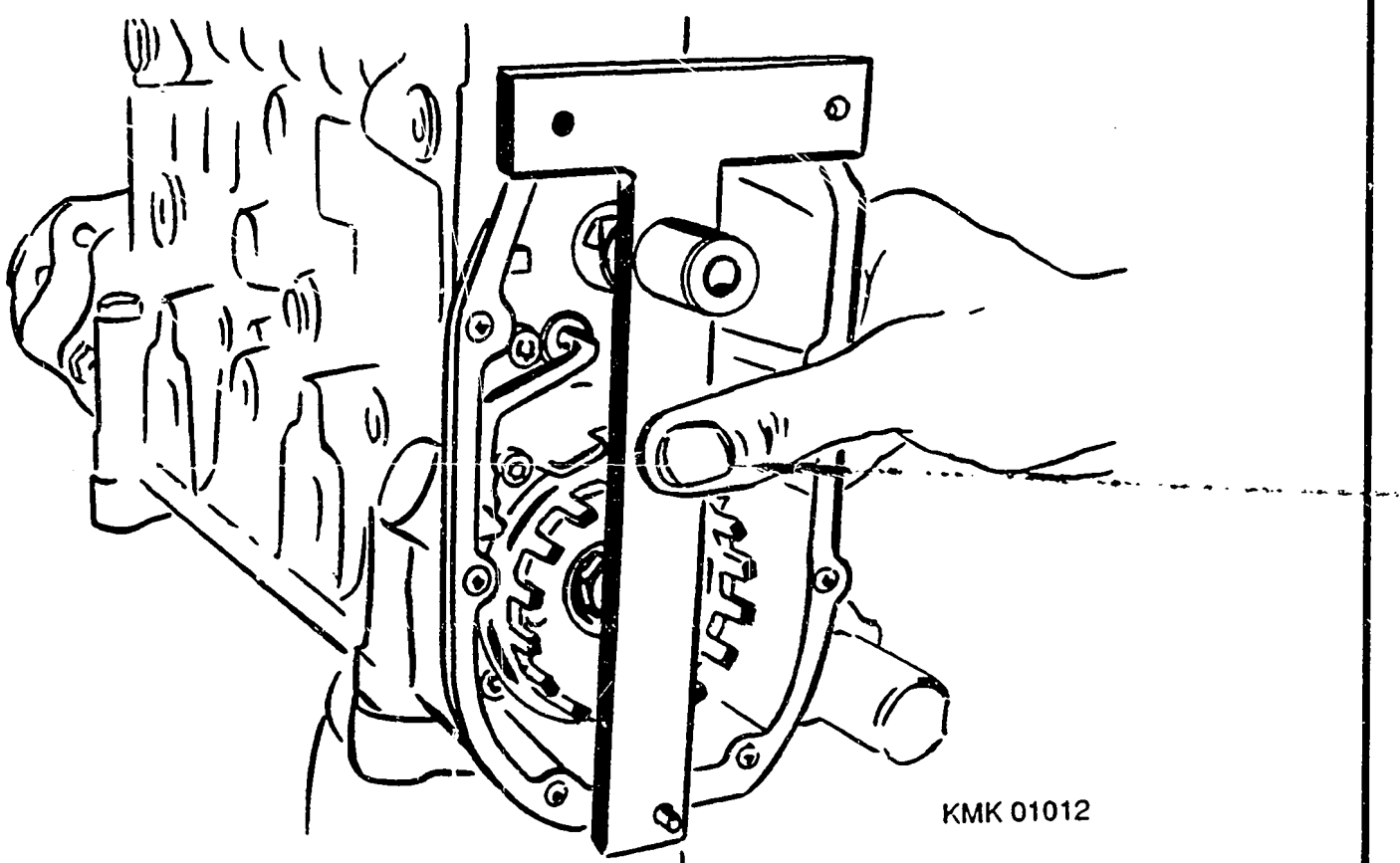


KMK 01011

DISASSEMBLING POSITIONER

Prior to further disassembly, check position of rack-position-sensor shorting ring at control rod with setting gauge 0 986 612 308 (KDEP 1703). This must be done because it is not possible to check the position of the shorting ring on the subsequently removed control rod (complete assembly with bush, spring, plate washer with shorting ring and cap nut).

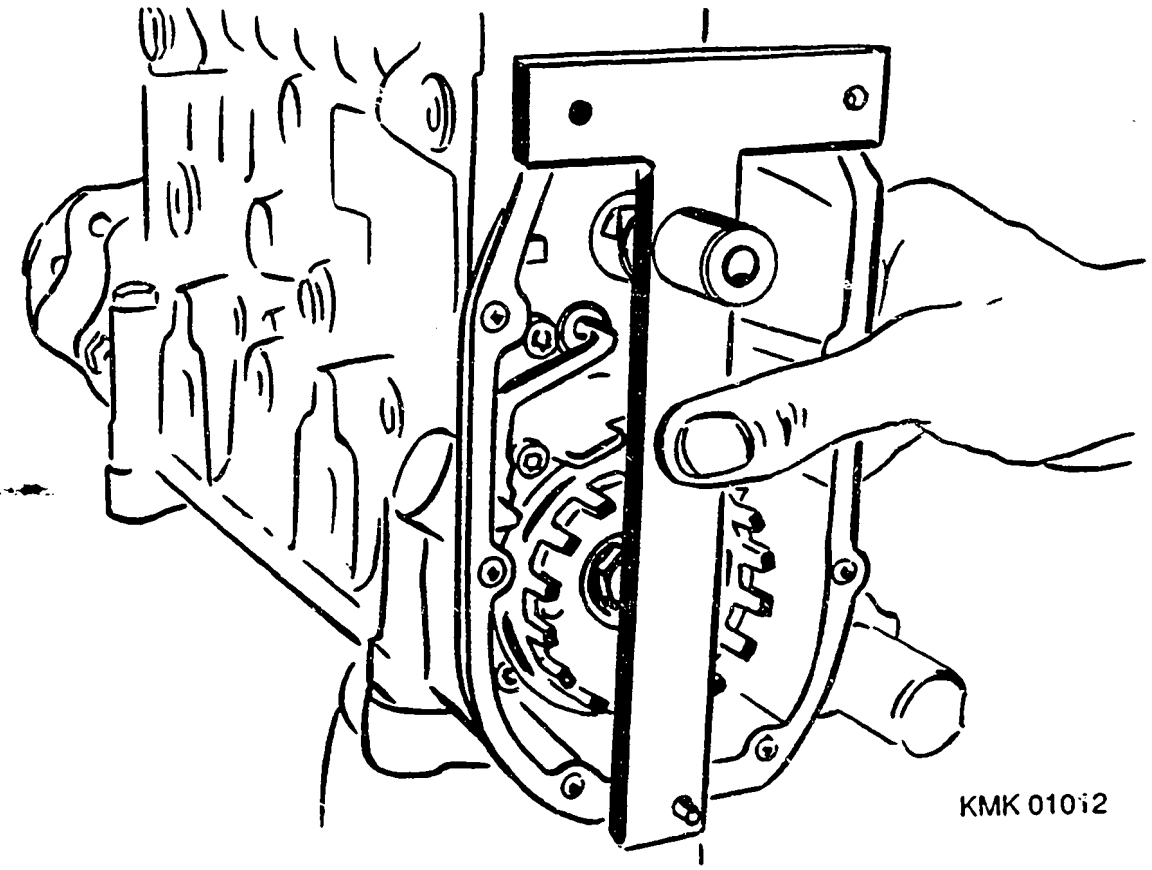
Continue: B09/1 Fig.: B08/2



POSITIONER DISASSEMBLY

Position setting gauge against housing with retracted measuring pin (positioning hole at bottom, tapped hole top left). It must be possible to insert the 1st stage (smallest diameter) of the measuring pin into the shorting ring and make contact with it in the bottom left corner (refer to illustration, next coordinate).

Continue: B10/1 Fig.: B09/2

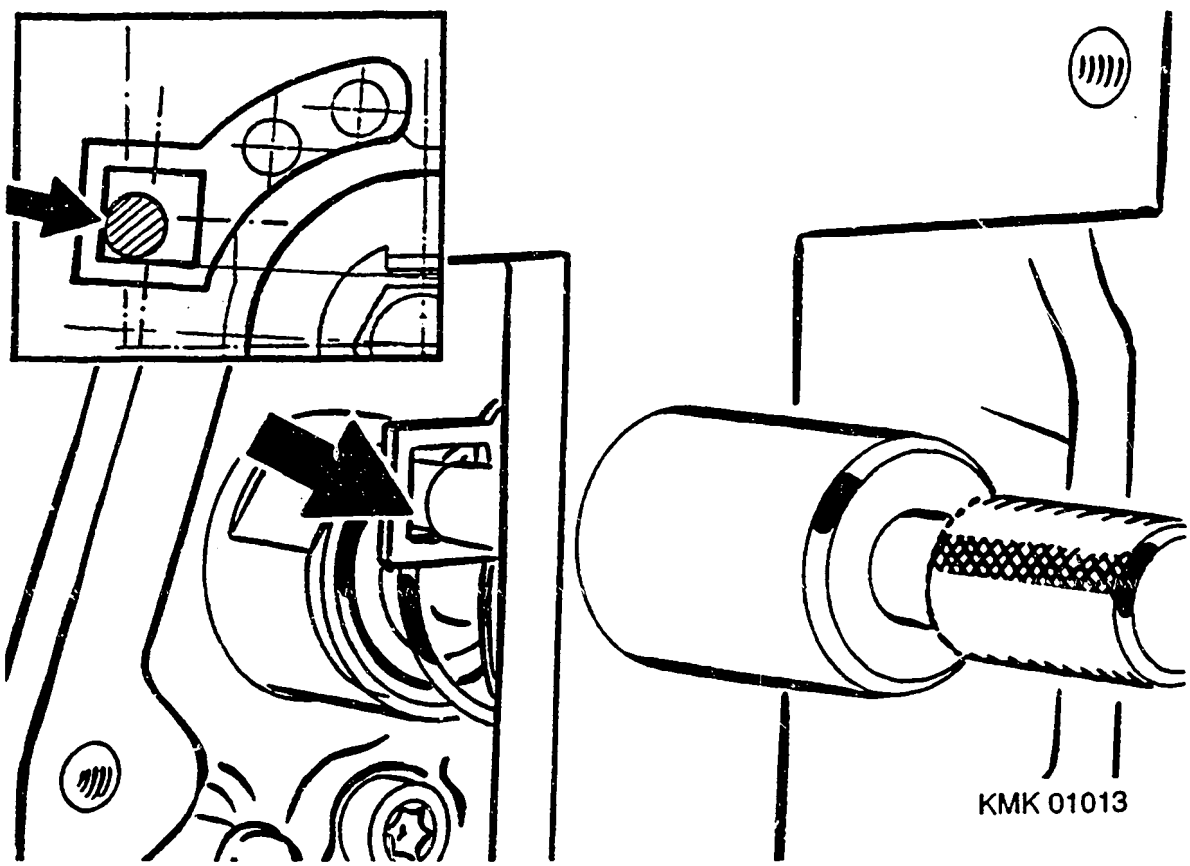


POSITIONER DISASSEMBLY

Position of measuring pin (smallest diameter – arrow) in shorting ring.

If position of shorting ring does not correspond to setting gauge, replace control rod (entire unit). In other words disassemble fuel-injection pump.

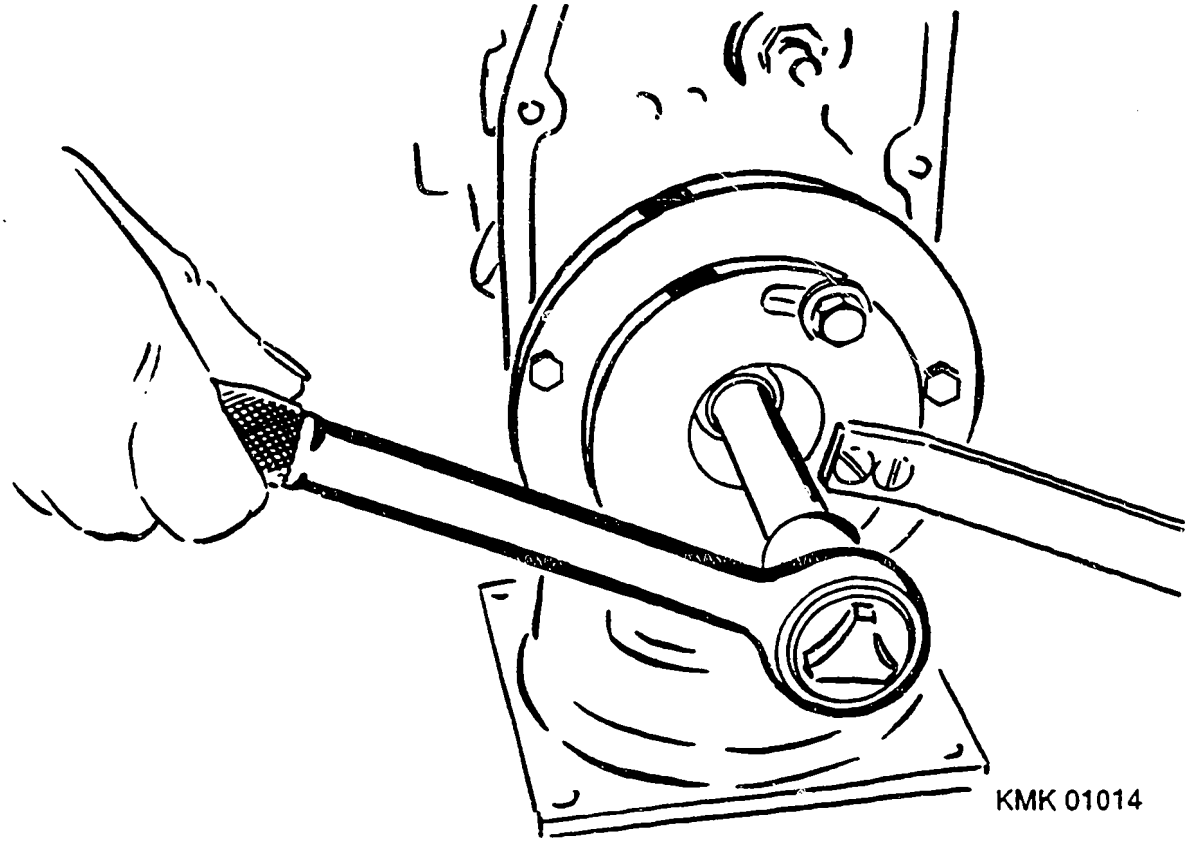
Continue: B11/1 Fig.: B10/2



DISASSEMBLING POSITIONER

Removing speed-sensor pulse wheel:
Screw on retaining plate of holding device 0 986 612 305 (KDEP 1702) at 4 tapped holes on bottom of positioner housing, but do not as yet tighten the 4 screws. Insert adjusting ring of holding device such that pins engage in pulse wheel.
Screw adjusting ring to retaining plate at slot; this involves turning camshaft accordingly. Screw down retaining plate.
Unscrew fastening nut of pulse wheel.
Remove holding device.

Continue: B12/1 Fig.: B11/2



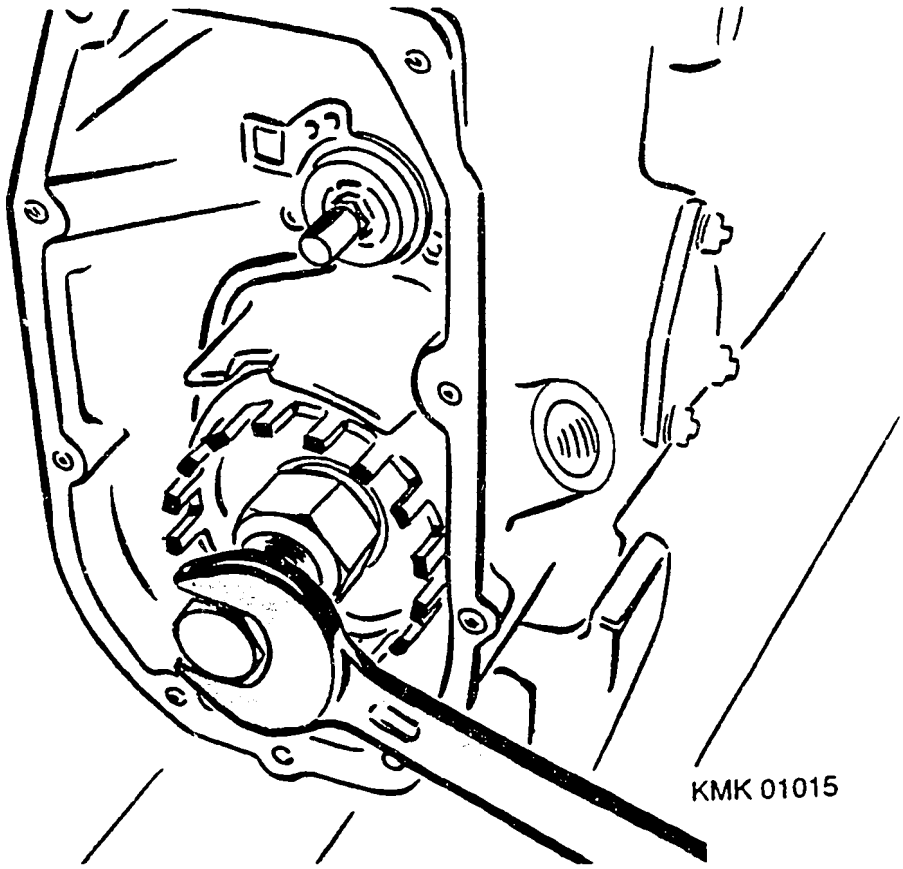
DISASSEMBLING POSITIONER

Use puller 0 986 618 245 (KDMZ 6999) to remove pulse wheel from taper of camshaft.

This forces the oil pump out of the guide pins. Pay attention to spring.

Remove oil pump, spring and hose.

Continue: B13/1 Fig.: B12/2

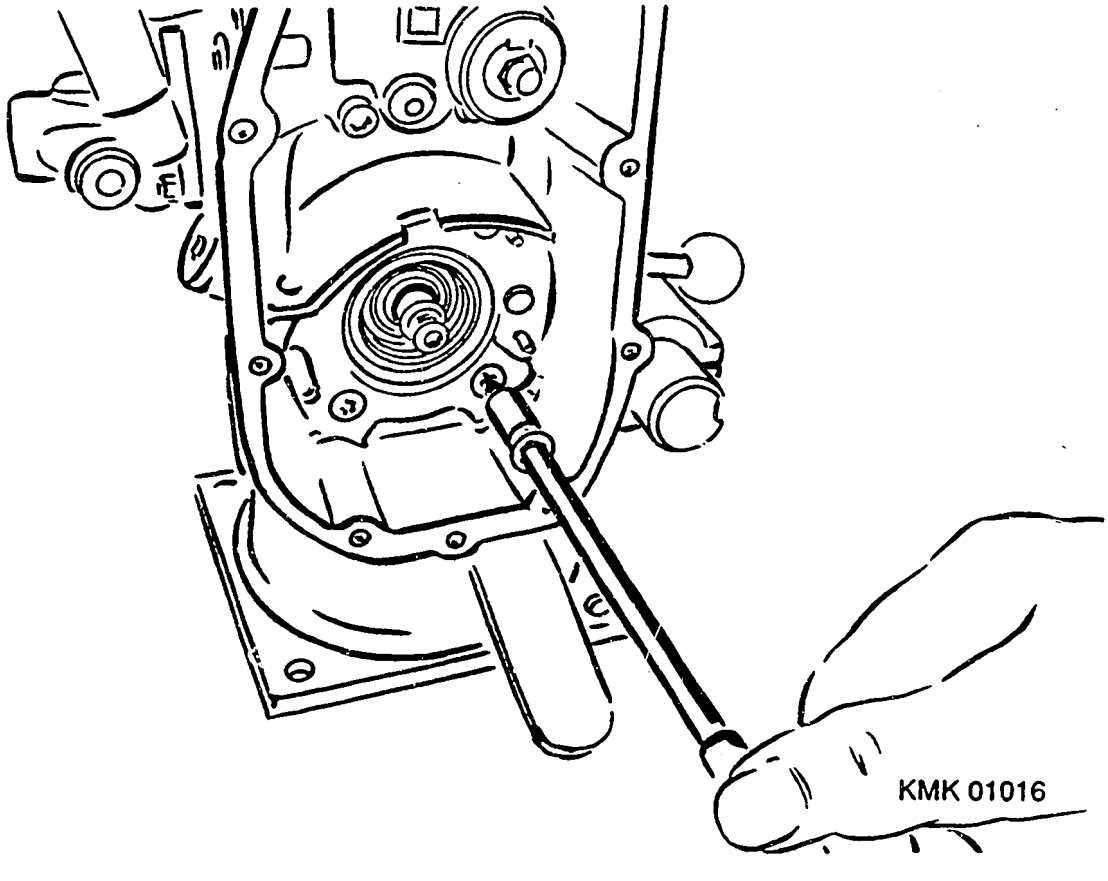


POSITIONER DISASSEMBLY

Remove positioner housing (if required, e.g. before disassembly of fuel-injection pump):

Screw out housing fastening screws (8 Torx screws) and remove housing with intermediate flange (positioner version RE 30) or with shim for camshaft projection (positioner version RE 24)

Continue: N27/2 Fig.: B13/2



CLEANING AND CHECKING OF INDIVIDUAL COMPONENTS

Wash out components in commercially available cleaning agent, such as Chlorothene NU, which is not readily flammable and then blow out with compressed air.

Important: When cleaning positioner cover, cleaning agent must not be allowed to get into the armature gap of the servo-magnet and the vent duct for the magnet.
When cleaning/replacing the magnet, always pay attention to the instructions as of coordinate
Extreme care should be taken when cleaning other components of cover.

Continue: C15/1

CLEANING AND CHECKING OF INDIVIDUAL COMPONENTS

Pay attention to the following safety regulations:
Order Governing Work with Flammable Liquids (Vbf) as issued by the Federal Ministry of Labor (BmA).
Safety regulations for handling chlorinated hydrocarbons:
companies ZH 1/222
employees ZH 1/129
as published by the Hauptverband für gewerbliche Berufsgenossenschaften (Zentralverband für Unfallschutz und Arbeitsmedizin),
Langwartweg 103, 5300 Bonn 5.
The appropriate local regulations are to be observed in other countries.

Continue: B15/1

CLEANING AND CHECKING OF INDIVIDUAL COMPONENTS

Oil pump:

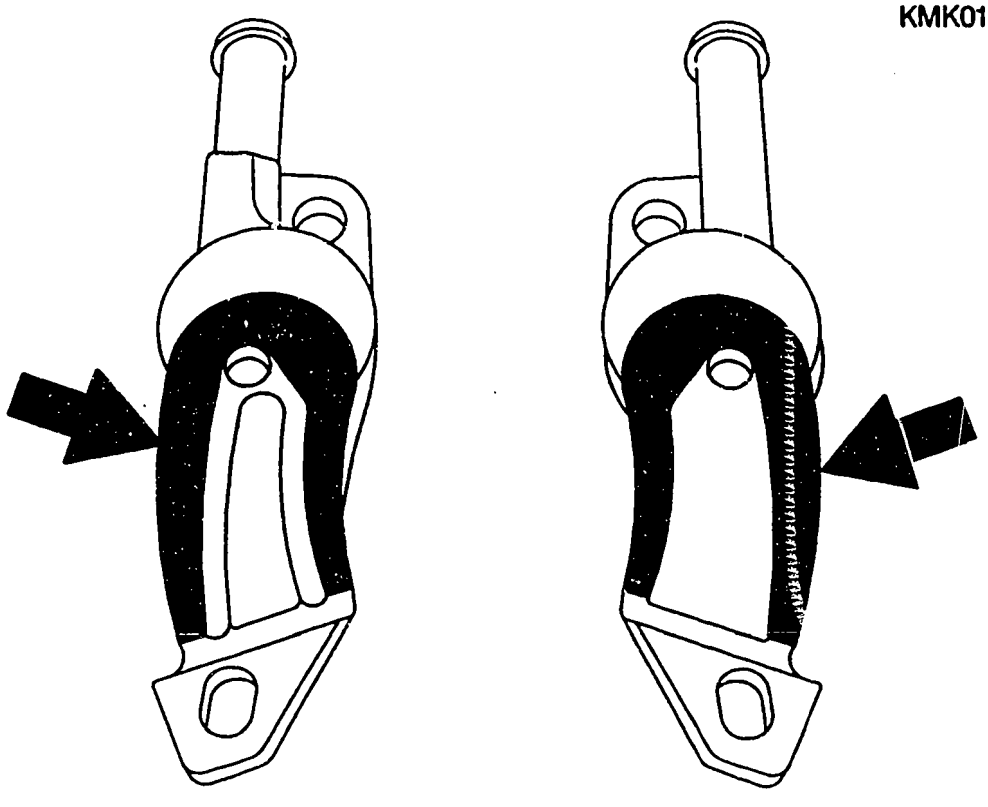
Renew oil pump with damaged/scored bearing surface (arrows).

Note: There are two oil pumps with opposing housing curvature depending on the direction of rotation of the fuel-injection pump:
Mounted on left as viewed from pulse-wheel side for counter-clockwise (Fig. 1) and mounted on right for clockwise (Fig. 2).

The oil hoses also have different shapes and only fit the appropriate version.

Continue: B16/1 Fig.: B15/2

KMK01017



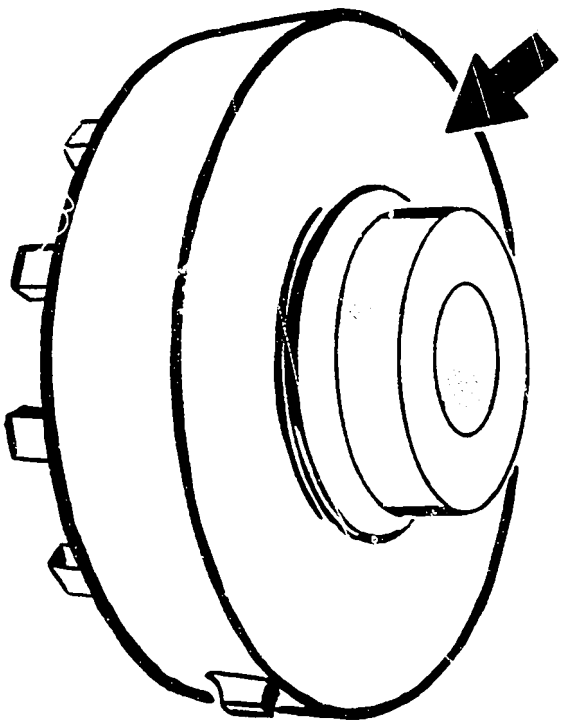
CLEANING AND CHECKING OF INDIVIDUAL COMPONENTS

Speed-sensor pulse wheel:

The ground bearing surface for the oil pump on the back of the pulse wheel (arrow) must not be damaged or scored. Replace pulse wheel if necessary. When doing so, make sure that correct pulse wheel is fitted. The number of pulse vanes must be equal to twice the number of injection-pump barrels.

Further testing of the pulse wheel is to be carried out following installation.

Continue: B17/1 Fig.: B16/2



KMK 01018

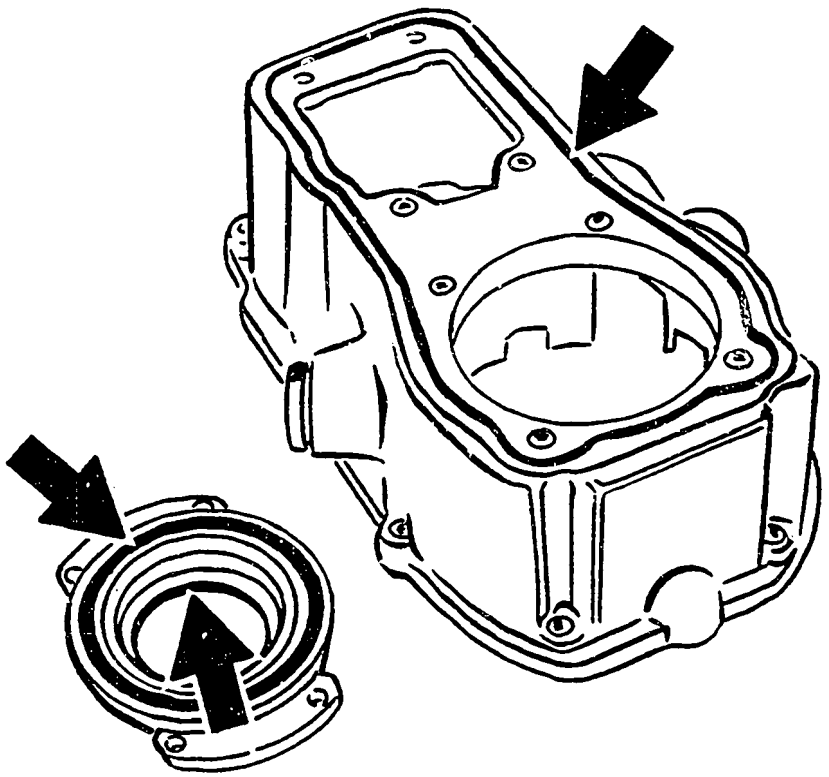
CLEANING AND CHECKING OF INDIVIDUAL COMPONENTS

Seal rings:

The radial-lip-type oil seal in the housing (RE 24)/in the intermediate flange (RE 30), the seal rings (arrows, picture shows RE 30) and the housing sealing plate (RE 24) are always to be renewed after disassembly.

Apply a small quantity of lubricant to outside of radial-lip-type oil seal, coat sealing lips with a thin layer of hot bearing grease and press in so as to be flush with housing.

Continue: B18/1 Fig.: B17/2



KMK 01019

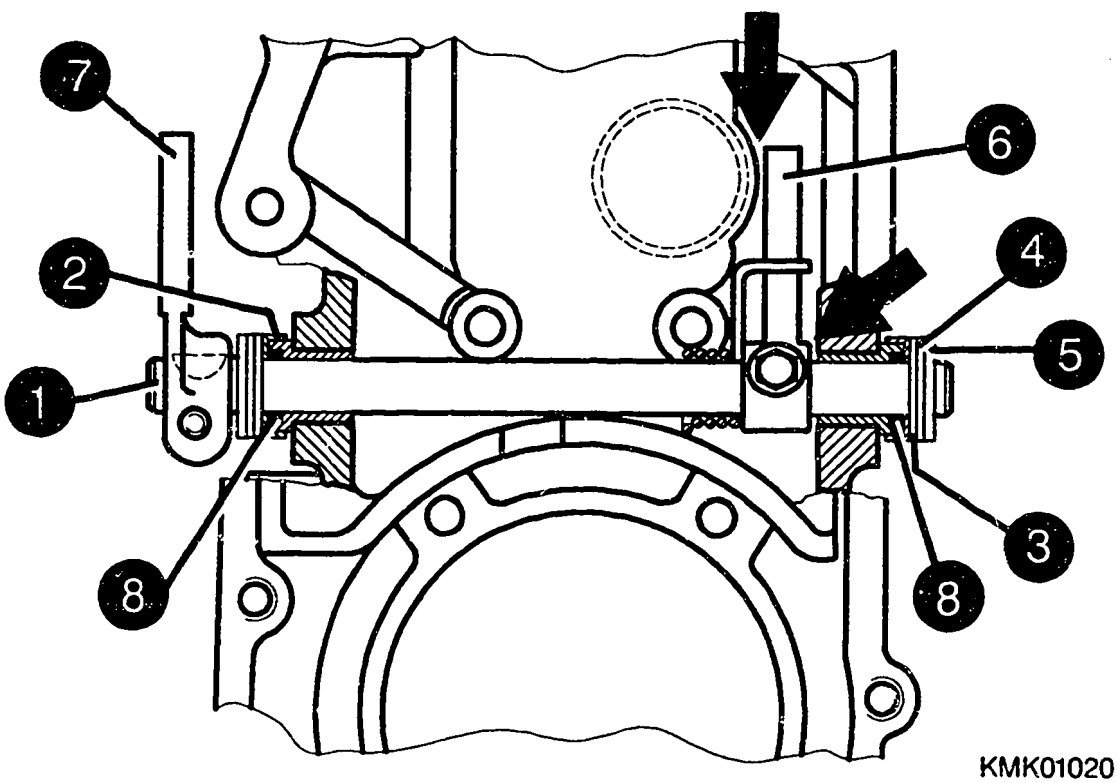
CLEANING AND CHECKING OF INDIVIDUAL COMPONENTS

Stop lever and shaft (where appropriate):

The shaft (1) should not have any obvious radial play. The bushes are permanently bonded in and cannot be replaced.

Axial clearance: 0.15...0.30 mm. Adjustment can be effected by way of the outer shims (3, 4).

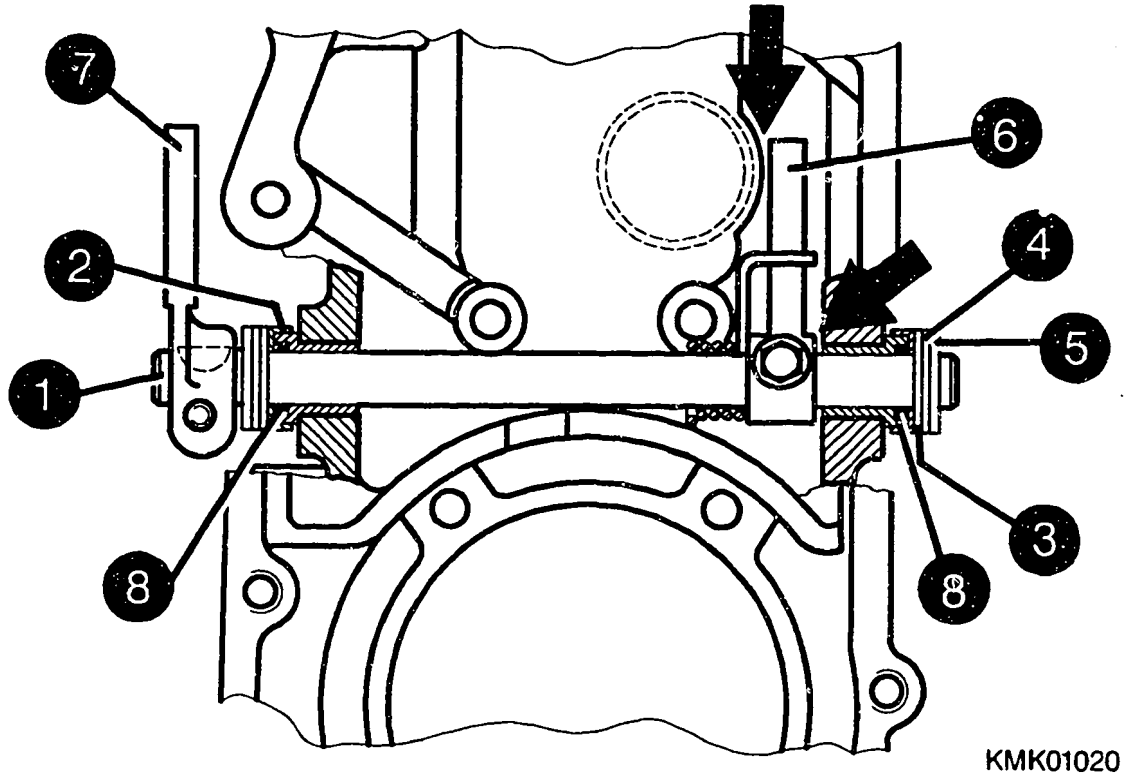
Continue: B19/1 Fig.: B18/2



CLEANING AND CHECKING OF INDIVIDUAL COMPONENTS

The O-rings (8) of the shaft bearing seal, which can be disassembled from outside, should always be replaced when performing positioner repairs.
To do so, remove stop lever (7), retaining springs (5), shims (3, 4) and plate washers (2).
Distribute shims at both bearings such that inner stop lever (6) can move freely and such that it cannot make contact with either the positioner housing or the control-rod bush (arrows).

Continue: N27/2 Fig.: B19/2



KMK01020

TESTING POSITIONER COVER

All electrical components – servo magnet, rack position sensor, speed pulse generator and 7-pole plug plate – are installed in the positioner cover which is the main component of the RE positioner.
These components are to be tested and can be individually replaced in the event of a fault.

Continue: B20/2

CHECKING POSITIONER COVER

Visual inspection:

The positioner cover and the components in it must be free from dirt and chips (speed-sensor terminal is permanently magnetic).

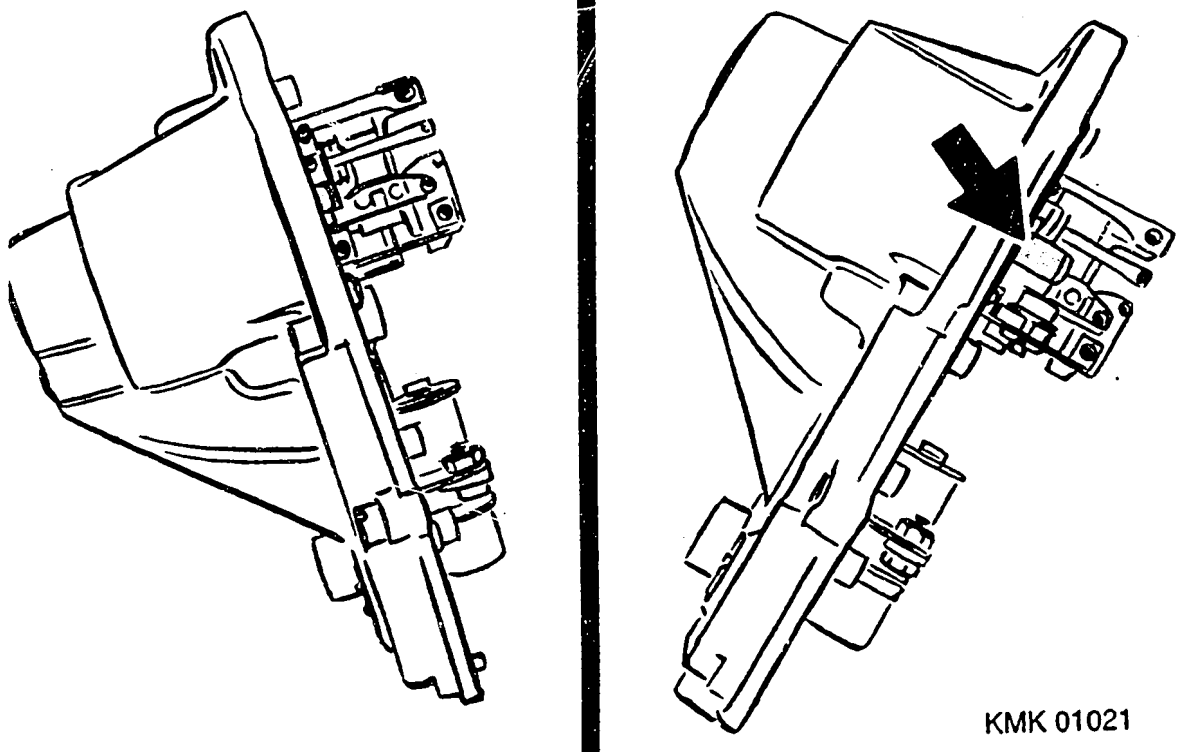
The individual components and the sealing surface of the positioner cover must not exhibit signs of mechanical damage.
Testing of the individual components is described in the following.

Continue: B21/1

CHECKING POSITIONER COVER

Checking freedom of movement of servo-magnet (magnet in situ):
When the positioner cover is inclined approx. 30 Grad from the perpendicular (approx. 30 Grad magnet tilt) in both directions, the weight of the armature must cause it to move to the respective stop.
If this is not the case, remove magnet, clean armature and armature bore and apply small quantity of engine oil SAE 20 W 20 to both. Replace magnet if this does not produce freedom of movement. For removal and installation refer to coordinate: C15/1

Continue: B22/1 Fig.: B21/2



CHECKING POSITIONER COVER

Checking freedom of movement of servo-magnet:

Important:

Checking the freedom of movement of the armature as described above did not involve removing the magnet. This suffices if the fuel-injection pump is not specifically thought to be sticking. One-sided wear of the armature bush, such as may occur after lengthy running, may result in stiffness during operation, which cannot be detected in the course of this test.

Continue: B22/2

CHECKING POSITIONER COVER

Important:
Removal of the magnet and precise measurement of the bearing clearance are an absolute must in the case of pumps with many hours of operation, general overhaul or a concrete complaint about "unstable engine idling behavior" (in the event of considerable instability combined with the error message "permanent system deviation").

For removal and installation of magnet see coordinate: C15/1

For measurement process see following coordinate.

Continue: B23/1

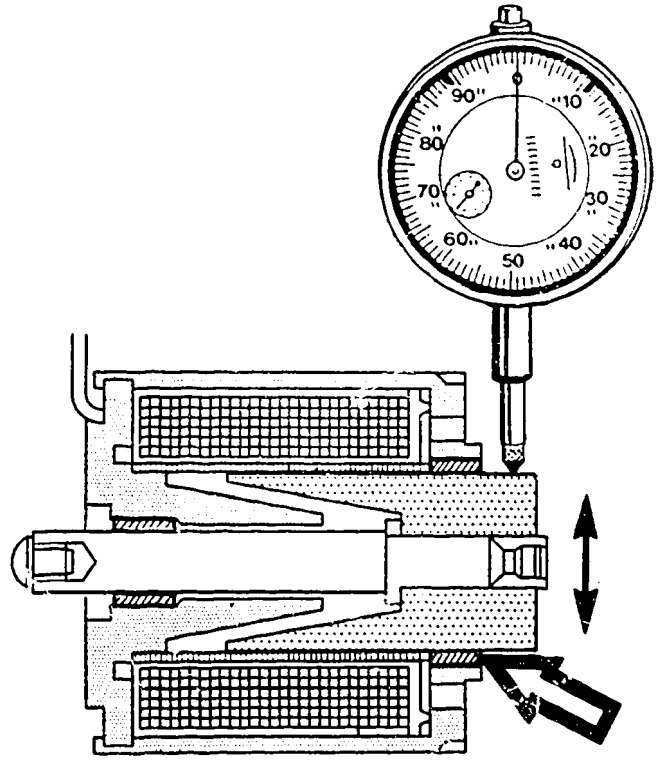
CHECKING POSITIONER COVER

Checking large bearing bush in servo-magnet (arrow) for wear:

To perform check, place magnet in prism and pull out armature slightly. Position dial indicator (e.g. 1 687 233 011) with stand (e.g. 4 851 601 124) on armature. Move armature up and down whilst turning magnet in prism and thus measure maximum bearing clearance.

The maximum bearing clearance of the large bush may be 0.16 mm. Replace magnet if this value is exceeded.

Continue: B24/1 Fig.: B23/2



KMK 03078

TESTING POSITIONER COVER

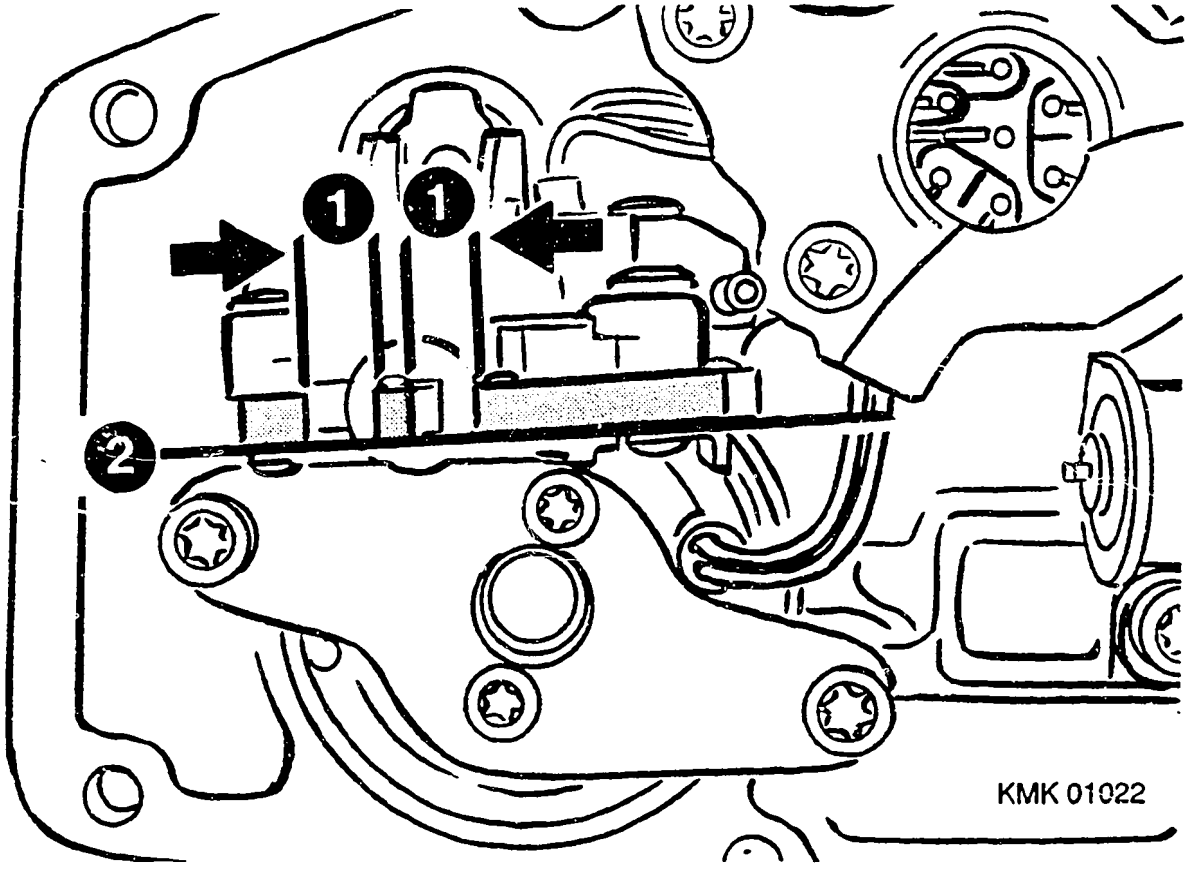
Rack position sensor, mechanical testing:

The rack position sensor must not exhibit mechanical damage or be bent.

The measuring arm must be centered with (1) and in alignment with (2) the two outer arms.

Is the rack position sensor in proper mechanical working order?

Yes: B26/1 No: B25/1 Fig.: B24/2



TESTING POSITIONER COVER

Replace damaged rack position sensor.
When doing so pay attention to removal
and installation instructions as of
Coordinate: C17/1

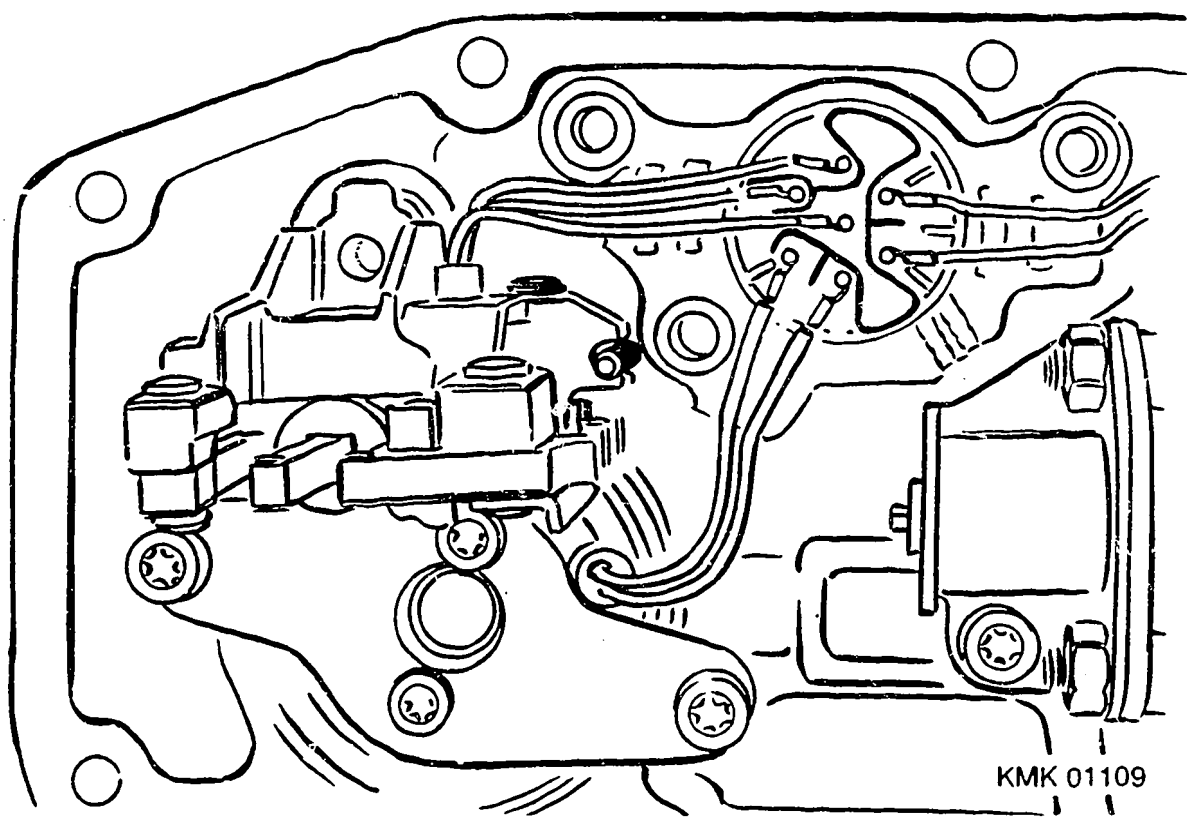
Continue: B26/1

CHECKING POSITIONER COVER

Electrical positioner connections, inner:

Check proper condition of soldered joints, strength of soldering-tab crimps on leads and proper condition/ proper laying of leads. In case of doubt, re-solder joints; where necessary replace appropriate component if leads are damaged.
Refer to repairing positioner cover as of coordinate: C12/1

Continue: B27/1 Fig.: B26/2



CHECKING POSITIONER COVER

Electrical positioner connections, inner:

Additionally check strength of lead crimps in soldering tabs by way of visual assessment:

Visual assessment involves the use of an illuminated magnifier (min. 6x magnification, e.g. Bosch 1 687 600 005) or a workshop microscope (with 10x magnification).

Continue: B27/2

CHECKING POSITIONER COVER

Electrical positioner connections, inner:

Particular attention is to be paid to the crimp connections of the thinner leads of the speed sensor and rack position sensor.

Note: Positioners as of the start of series production up to date of manufacture 266 may be affected by poor crimps. Testing is especially necessary with these positioners so as to reliably preclude the possibility of occasional loose contacts.

Continue: B28/1

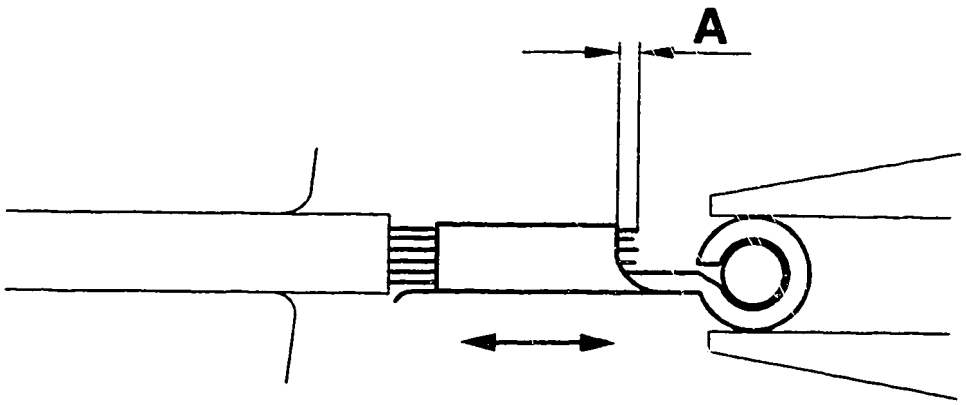
CHECKING POSITIONER COVER

Electrical positioner connections, inner:

- Unscrew cover plate of 7-pin terminal board.
- Remove oil residues from area of lead crimps.
- Lift each lead of rack position sensor and speed sensor out of cable duct and move back and forth with tweezers or the like in stranded-wire direction whilst observing crimp under magnifier or microscope. In doing so, hold soldering tabs with tweezers. Take care not to kink leads.

Continue: C01/1 Fig.: B28/2

KMK04056



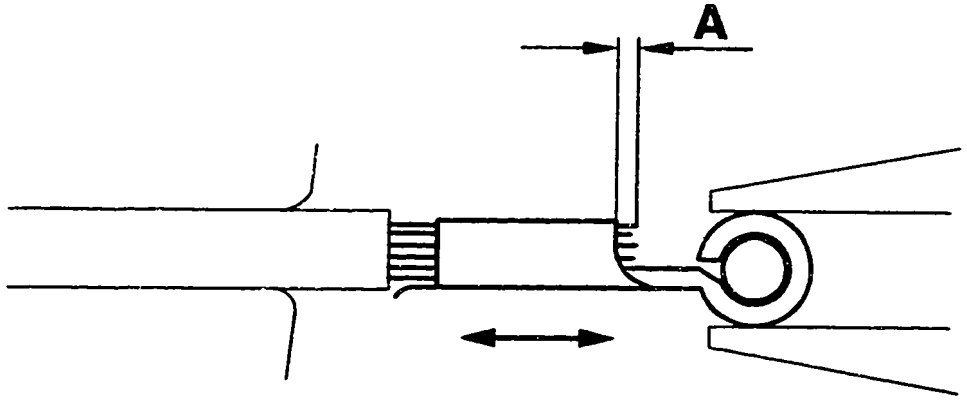
CHECKING POSITIONER COVER

Electrical positioner connections, inner:

- Moving the lead must not alter the length of the projecting end of the stranded wire (dimension A, see picture). The crimp connection is defective if there is the slightest discernible relative movement between end of stranded wire and crimp.
- Note: The distance between crimp and lead insulation is unsuitable for assessment on account of its flexibility.
  If crimp connection is loose, corresponding component is to be replaced.

Continue: C02/1 Fig.: C01/2

KMK04056



CHECKING POSITIONER COVER

Electrical positioner connection, outer:

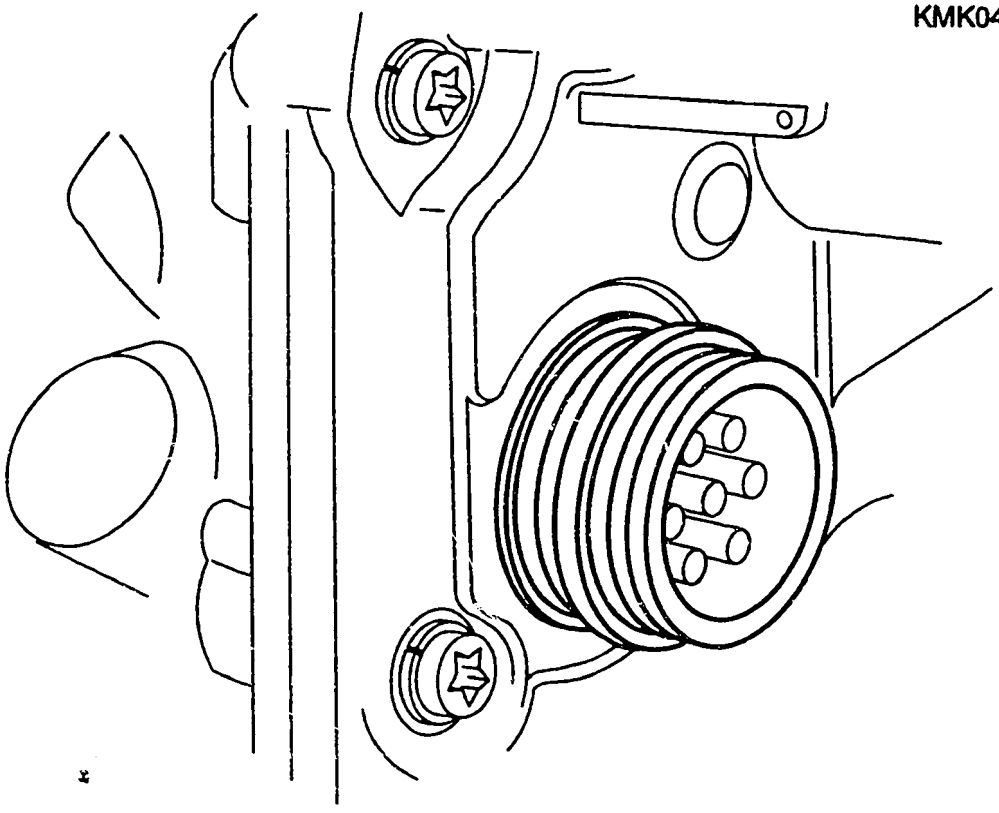
Positioner version with housing-fixed round screw connection:

Check thread for damage (e.g. due to connector cap nut being fitted at an angle). Rework thread if necessary or replace entire plug board.

Refer to repairing positioner cover, coordinate: C12/1

Continue: C03/1 Fig.: C02/2

KMK04476



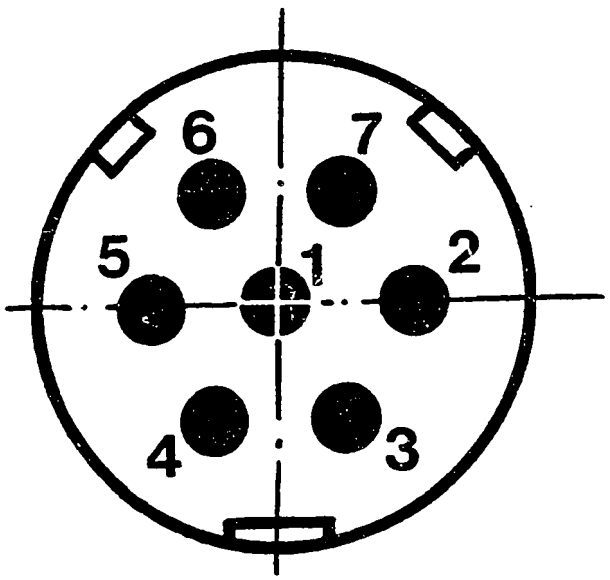
CHECKING POSITIONER COVER

Positioner with housing-fixed round screw connection:

Check contact pins in plug housing for corrosion and erosion (due for example to loosely fitted connector). Replace entire plug board if necessary. Refer to repairing positioner cover, coordinate C12/1

Note: Avoid mechanical cleaning of contact pins, as this damages surface coating.

Continue: C04/1 Fig.: C03/2



KMK 01023

CHECKING POSITIONER COVER

Positioner version with cable bushing and overhung plug:

Check lead and plug for mechanical damage. Check for contact corrosion and erosion. If necessary, renew entire cable bushing with plug.
Refer to repairing positioner cover, coordinate: C12/1

Continue: C05/1

CHECKING POSITIONER COVER

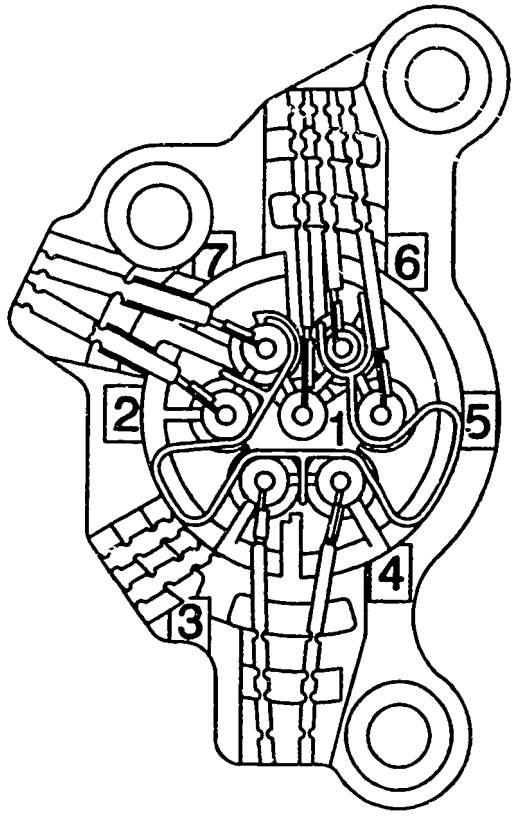
Resistance measurement for individual components at 7-pin positioner connection - solder side:

1-6 (RPS-coil 1)	17...23 Ohm
5-5 (RPS-coil 2)	17...23 Ohm
1-5 (RPS total)	34...46 Ohm
2-7 (Servo-magnet)	0.55...0.90 Ohm
3-4 (Speed sensor)	900...1200 Ohm

If resistance values are outside tolerance: Replace component concerned, see coordinate: C12/1

Continue: C06/1 Fig.: C05/2

KMK004477



CHECKING POSITIONER COVER

In the case of positioner version with cable bushing and overhung plug, check leads from plug to terminal board for continuity and short circuit.
Refer to following coordinates for plug assignment.
Test specifications:
Continuity test: 0 Ohm.
Mutual short circuit: infinity Ohm
Note the following when checking for short circuit: On checking the leads to a component, the value is not infinity Ohm, but rather in line with the coil resistance of the component.

Continue: C07/1

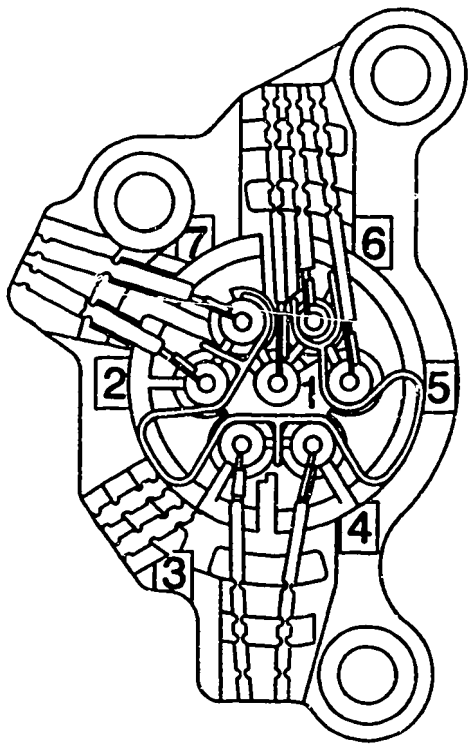
CHECKING POSITIONER COVER

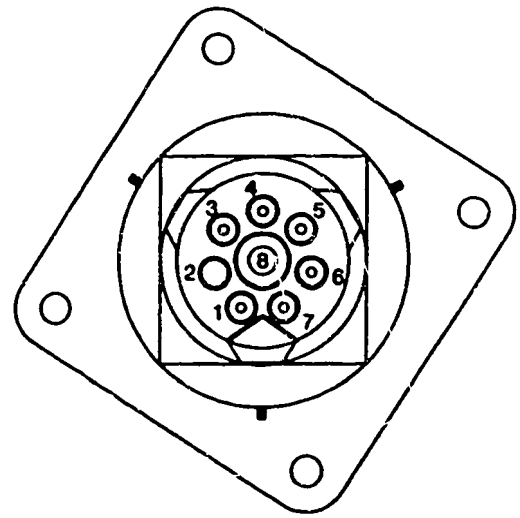
Plug assignment for positioner version
with cable bushing and overhung
Schlemmer plug (e.g. MAN):

Positioner solder pin	Color	Schlemmer plug
1	green	1
2	brown	8
3	blue	3
4	white	4
5	black	5
6	red	6
7	brown	7
	not used:	2

Continue: C08/1 Fig.: C07/2

KMK04478



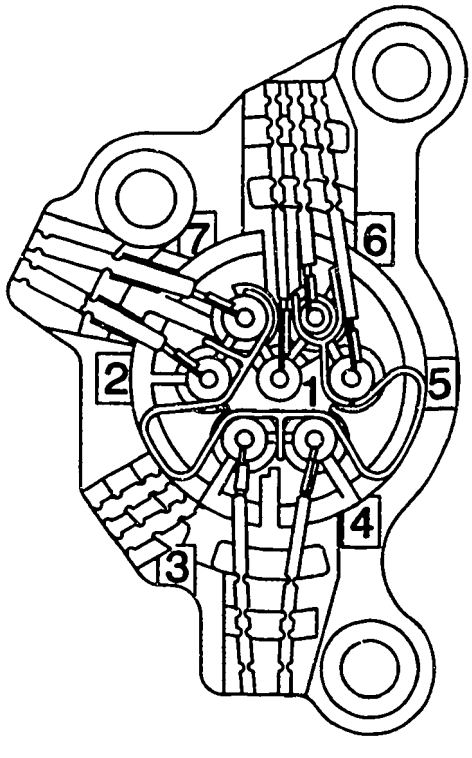


CHECKING POSITIONER COVER

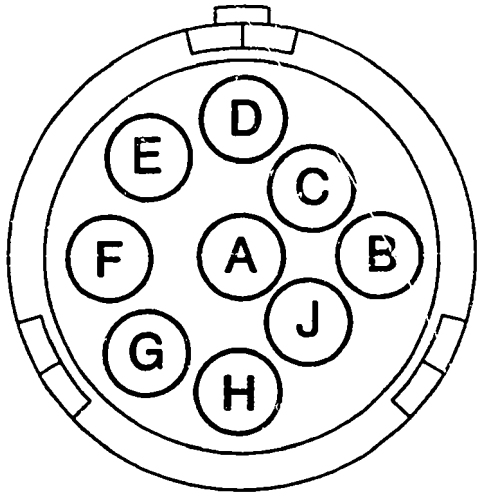
Plug assignment for positioner version
with cable bushing and overhung
Deutsch plug (e.g. Mack):

Positioner solder pin	Color	Deutsch plug
1	green	A
2	brown	B
3	blue	C
4	white	D
5	black	E
6	red	F
7	brown	G
	not used:	H
	not used:	J

Continue: C09/1 Fig.: C08/2



KMK04479



CHECKING POSITIONER COVER

If an electrical fault (open circuit, short circuit) is found or if there is mechanical damage to cable bushing, lead or plug, the entire cable bushing is to be replaced together with lead and plug.

Pay attention to removal and installation instructions as of coordinate: C27/1

Continue: C10/1

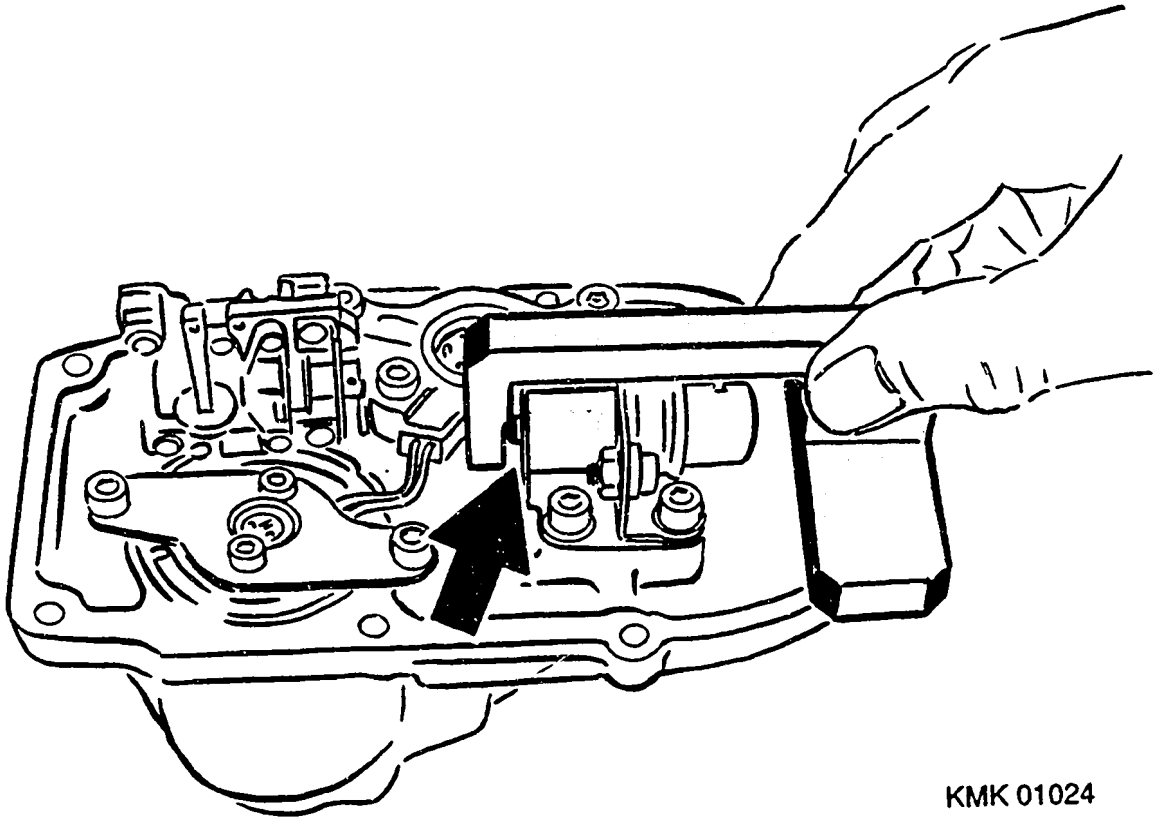
CHECKING POSITIONER COVER

Checking position of speed pulse generator:

Attach adjustment gauge 0 986 612 301 (KDEP 1701) to positioning pin of positioner cover. Check whether terminal of pulse generator makes contact with measurement surface of gauge without pressure being exerted (arrow).

OK?

Yes: C11/2 No: C11/1 Fig.: C10/2



KMK 01024

TESTING POSITIONER COVER

If necessary, screw adjustment gauge to positioner cover with screw. Loosen the three fastening screws of the pulse generator and move pulse generator until it makes contact with measurement surface of gauge.

Tighten fastening screws to tightening torque of 9...11 Nm.

Continue: C11/2

TESTING POSITIONER COVER

The positioner cover is now ready for assembly.

Should the positioner-cover tests described above have necessitated correction/assembly work, attention must always be paid to the repair instructions given in the following and to which reference has already been made in the individual Sections.

Were the required test results obtained without correction/assembly work?

Yes: N27/2 No: C12/1

REPAIRING POSITIONER COVER

Table of contents for individual repair operations:

Continue: C12/2

REPAIRING POSITIONER COVER

General:

All components of the positioner cover are available as service parts and can be replaced individually.

When doing so, always pay attention to the repair instructions given in the following. This applies not only to the assembly instructions, but also to the detailed instructions for proper soldering and positioning of the leads at the pins of the 7-pole terminal board.

Continue: C13/1

REPAIRING POSITIONER COVER

General (continued):

Positioner versions with cable bushing and overhung plug:
The cable bushing is available as a complete service part comprising terminal board with cable in correct length, crimped-on contact connector and loose plug components. The replacement of individual plugs is not envisaged, since proper and reliable crimping of the contact pins requires the use of the extremely expensive original crimping tools of the plug manufacturers.

Continue: C12/1

REPAIRING POSITIONER COVER

Component fastening screws:

The fastening screws for servo magnet, speed pulse generator and 7-pole plug plate are micro-encapsulated for self-locking purposes. The micro-encapsulation may become ineffective even after unscrewing the screw once (screw can be turned too easily). The procedure described in the following is thus to be employed.

Continue: C14/1

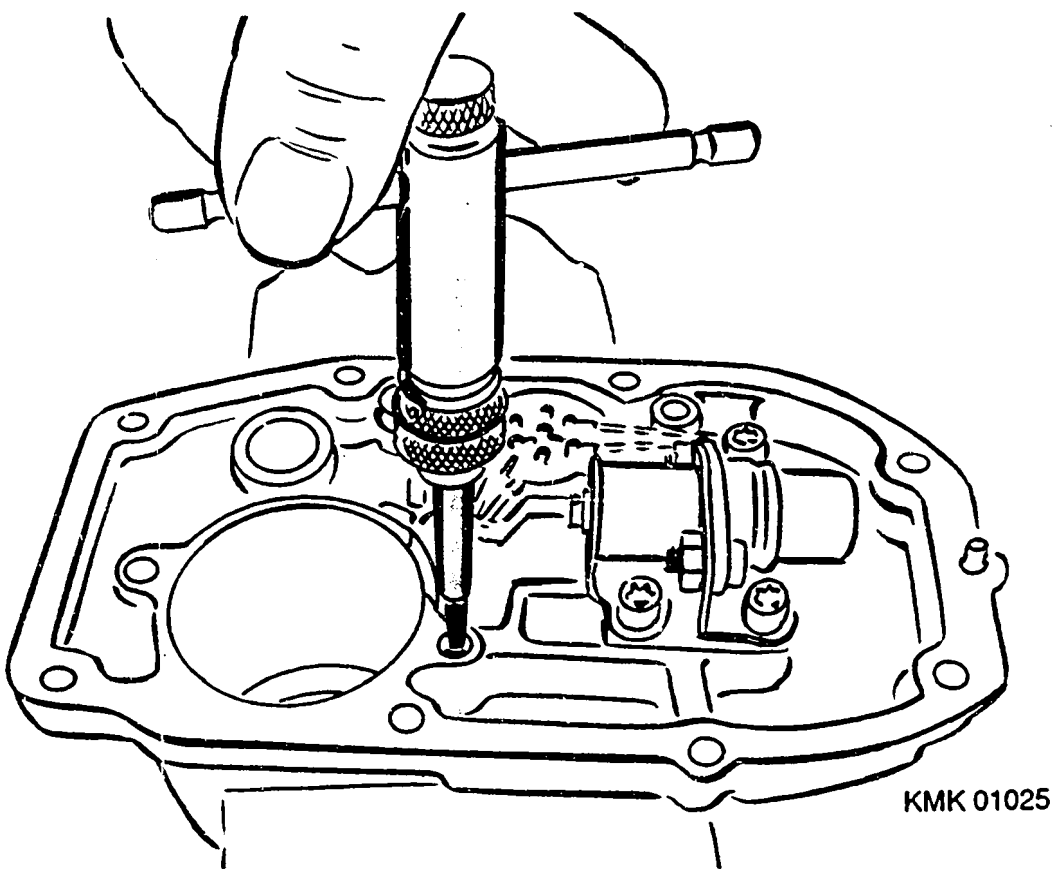
REPAIRING POSITIONER COVER

After removing component, clean tapped hole in positioner cover with tap (M 6) and blow out thoroughly with compressed air. The holes should be free from dirt and oil residue.

Likewise clean threads of screws with wire brush.

To assemble component, apply slight amount of Loctite 242 screw locking compound to screw threads, screw in and tighten to tightening torque of 9...11 Nm.

Continue: C12/1 Fig.: C14/2



REPAIRING POSITIONER COVER

Servo-magnet replacement:
This requires prior loosening of rack position sensor and possibly also unsoldering of rack-position-sensor leads.
Refer to Coordinate: D03/1

Unscrew cover plate of 7-pole plug plate (3 screws) to provide access to pins. Pull plastic insulating cap (if provided) out of plug plate.
Unsolder magnet connecting leads at pins 2 and 7.
Description of soldering process is given at Coordinate: D03/1

Continue: C15/2

REPAIRING POSITIONER COVER

Screw out fastening screws and replace magnet complete with flange plate.

Only dry magnet cleaning (e.g. armature and bore) is permitted; never use cleaning fluid.
In the case of reusable and new servo-magnets, installation is to be preceded by thorough lubrication of the armature and bore with oil SAE 20W20.
On installation, heed coordinates for:
Fastening screws: C13/2
Soldering-on of leads: D09/1
Installation of RPS: C17/1

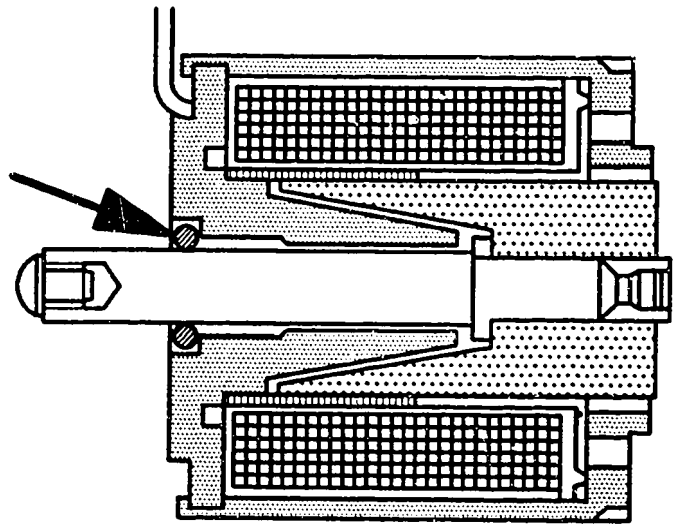
Continue: C16/1

REPAIRING POSITIONER COVER

Note on new servo-magnets:

New servo-magnets feature an O-ring (arrow) in a groove in the area of the small bearing bore for the armature thrust pin to stop the armature dropping out. This O-ring must be removed before fitting a new servo-magnet. The required freedom of magnet movement is not obtained with the O-ring in position.

Continue: C12/1 Fig.: C16/2



KMK02236

REPAIRING POSITIONER COVER

Replacing rack position sensor:

The RPS fastening screw (clamping screw) is accessible from outside through a hole. The access hole is safeguarded against tampering by a closure cap and sealed.

When RE positioners were first produced, the anti-tamper safeguard took the form of a steel cap; use has been made of a plastic seal on versions as of approx. 1992.

Continue: C17/2

REPAIRING POSITIONER COVER

The two different closure caps are not mutually interchangeable. Both types thus remain available as service parts.

Removal of the two versions requires different procedures, which are described separately in the following:

Steel closure cap: C18/1
Plastic seal: C20/1

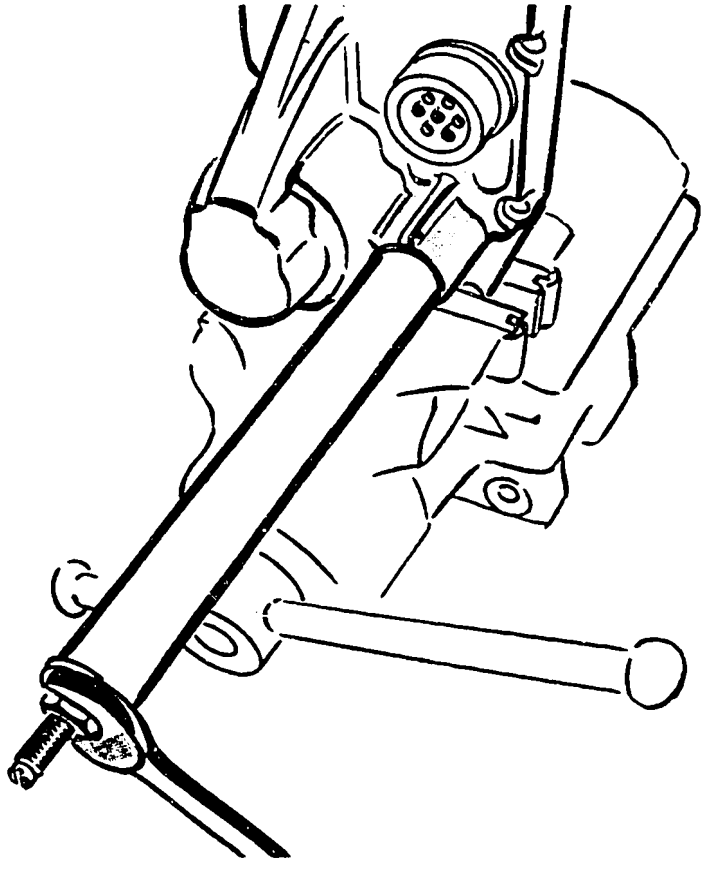
Continue: C18/1

REPAIRING POSITIONER COVER

Removing steel closure cap for RPS adjustment bore:

Remove closure cap with spring collet 0 986 619 225 (KDAW 9995/3), threaded pin and clamp pin 0 986 619 250 (KDAW 9995/14) and appropriate support tube (user manufacture): Loosely insert spring collet with threaded pin and clamp pin in closure cap. Tighten threaded pin and thus spread collet until it is firmly seated. Remove closure cap with support tube, washer and nut M 10.

Continue: C19/1 Fig.: C18/2



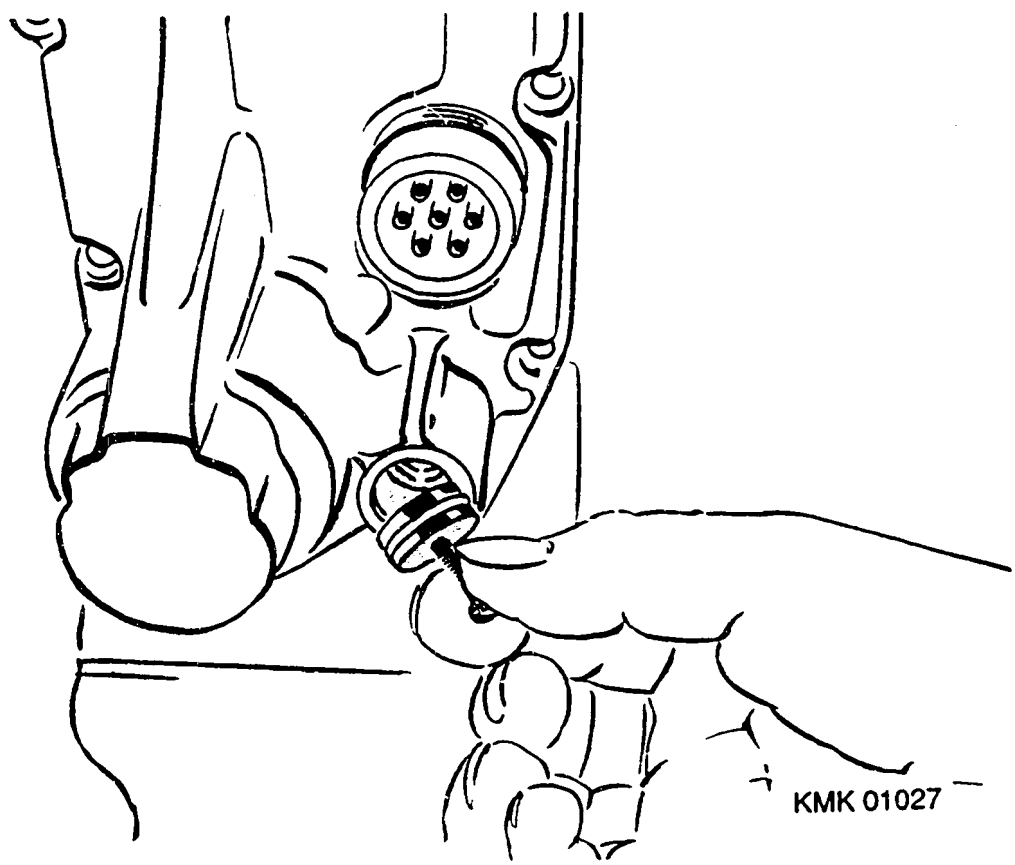
KMK 01026

REPAIRING POSITIONER COVER

Screw M4 screw into plug and pull plug (with seal ring) out of hole.

Note: Leave screw in plug if at all possible, so as to ensure that plug is subsequently installed correctly (tapped hole on outside).

Continue: C20/1 Fig.: C19/2



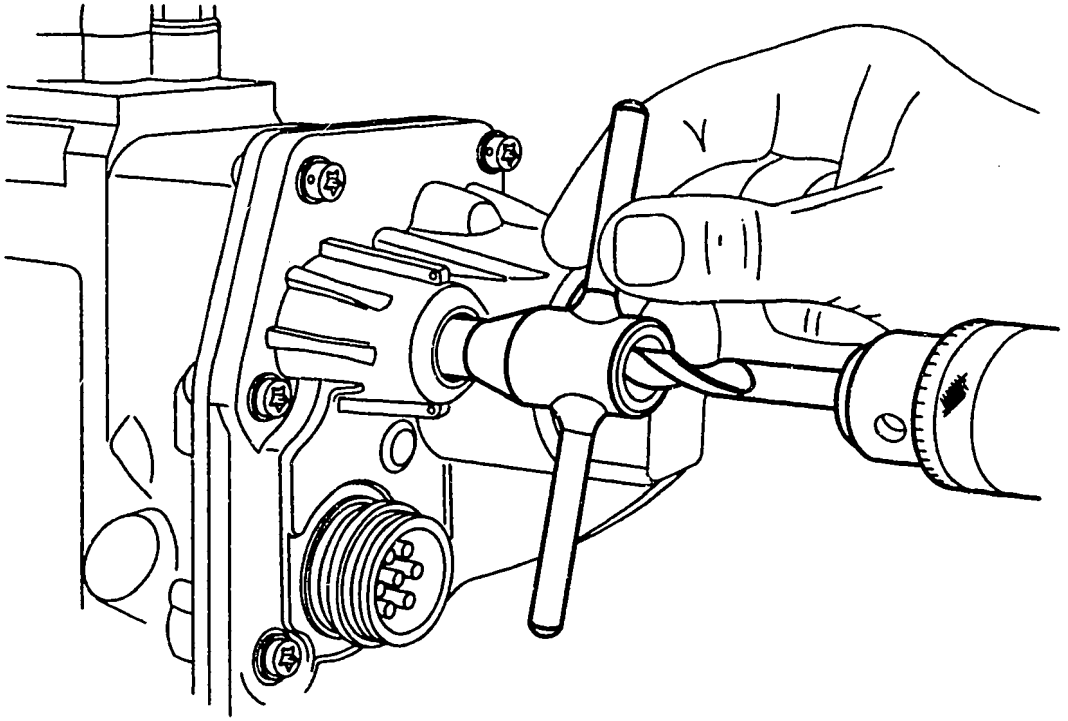
REPAIRING POSITIONER COVER

Removing plastic seal for RPS adjustment bore:

Seal can only be drilled out and destroyed with 12 mm drill. In doing so, secure seal with pin-type socket wrench 0 986 611 459 (KDEP 2990) to prevent it turning and drill out until it is pierced (retainers break off).
Attention: Drill at low speed and without exerting excessive force. Following penetration, pull back drill immediately to stop tip catching, as this will damage rack position sensor.

Continue: C21/1 Fig.: C20/2

KMK004480



REPAIRING POSITIONER COVER

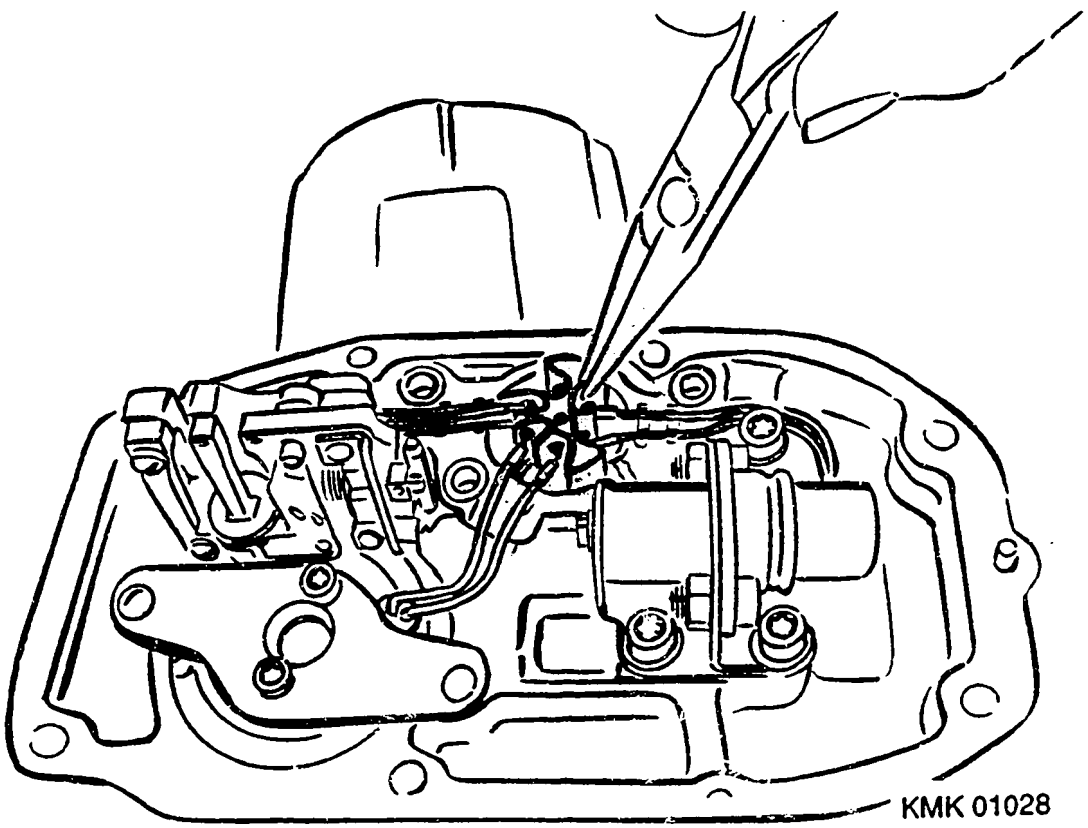
Removing rack position sensor:

Unscrew cover plate of 7-pin plug board (3 screws) to provide access to pins.
If fitted, pull plastic insulating cap out of plug board.

Unsolder connecting leads at pins 1, 5 and 6.

For description of soldering process refer to coordinate: D09/1

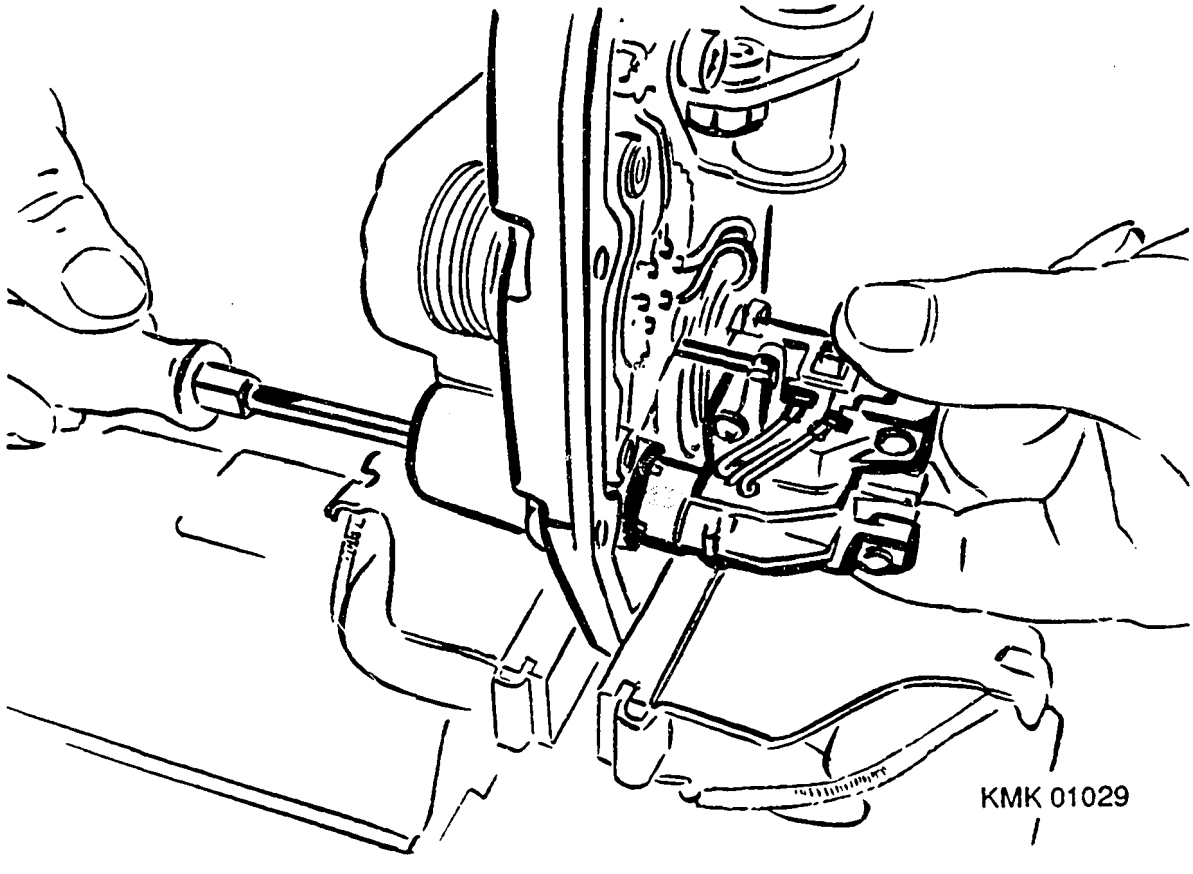
Continue: C22/1 Fig.: C21/2



REPAIRING POSITIONER COVER

Loosen rack-position-sensor clamping screw (hexagon socket 5 mm) and pull rack position sensor out of hole.

Continue: C23/1 Fig.: C22/2

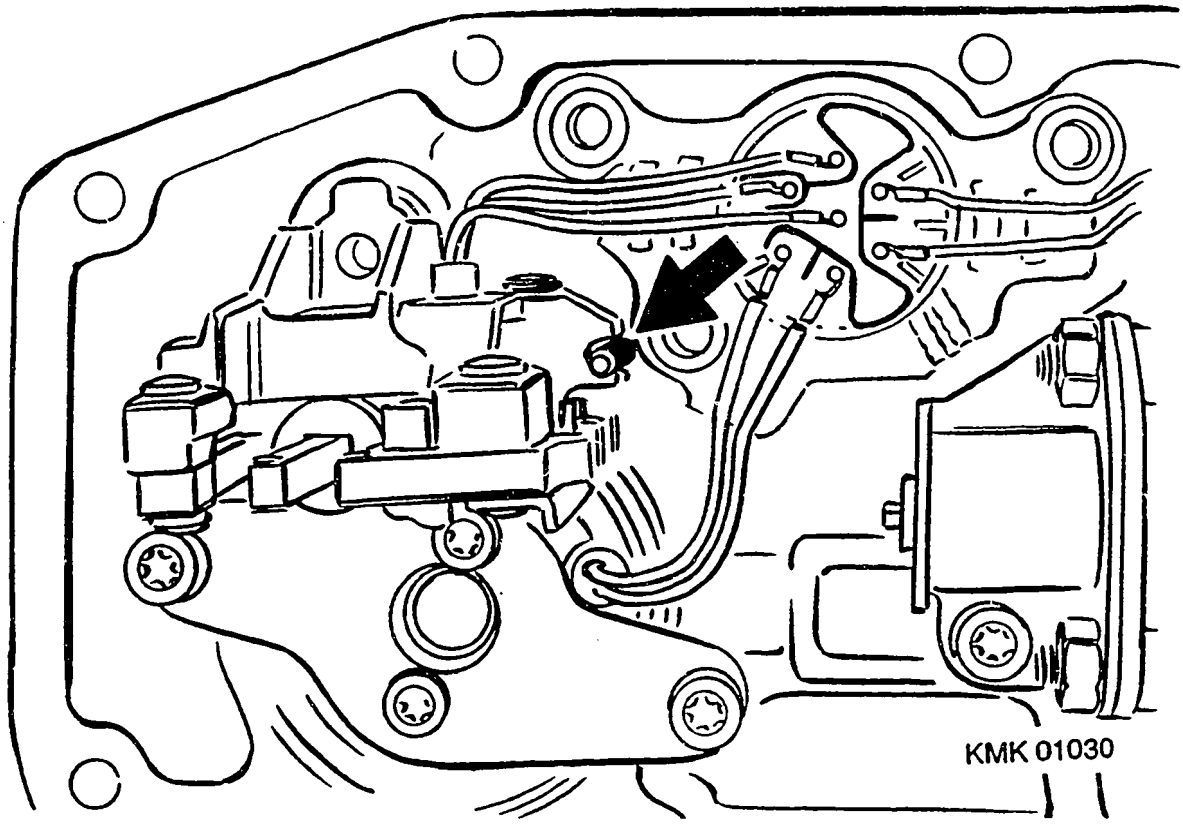


REPAIRING POSITIONER COVER

Note on new rack position sensor:
The tapered clamping screw is greased with Molycote grease. Ensure that periphery of clamping stem itself is free from grease. Do not screw in clamping screw with sensor removed, as otherwise clamping stem will be over-extended.

Insert rack position sensor as far as it will go, pay attention to guide in guide pin (arrow) and slightly tighten clamping screw.
For soldering on and laying of leads refer to Coordinate: D09/1

Continue: C12/1 Fig.: C23/2

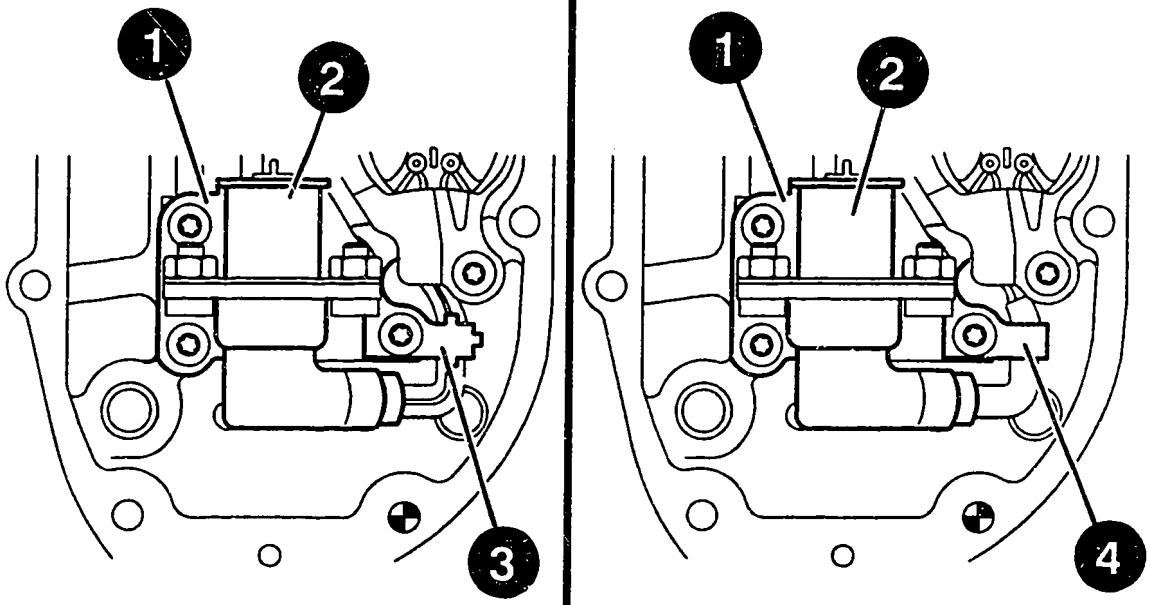


REPAIRING POSITIONER COVER

Replacing speed sensor:
Depending on positioner version the speed sensor has two different backing plates (picture, 1); on the one hand for cable attachment with rubber moulding (3, left) and on the other for cable attachment with flexible tube (4, right). The actual pulse generator (2) is the same in both cases (remove tube if necessary). If the pulse generator in the backing plate is to be replaced, use is either to be made of new screws (micro-encapsulated) or the old screws are to be cleaned and fitted using Loctite 242.

Continue: C25/1 Fig.: C24/2

KMK004481



REPAIRING POSITIONER COVER

Replacing speed sensor:

Unscrew cover plate of 7-pin terminal board (3 screws) to provide access to solder pins.

If fitted, remove plastic insulating cap from terminal board.

Unsolder connecting leads at pins 3 and 4.

For description of soldering process refer to coordinate: D09/1

Continue: C25/2

REPAIRING POSITIONER COVER

Screw out three fastening screws of backing plate and replace speed sensor complete with backing plate.

Refer to notes on fastening screws, see: C13/2

On installation, lay leads such that there is neither kinking nor tension and pay attention to correct position of rubber holder/flexible tubing beneath backing plate. Screws are only to be tightened slightly at first.

Continue: C26/1

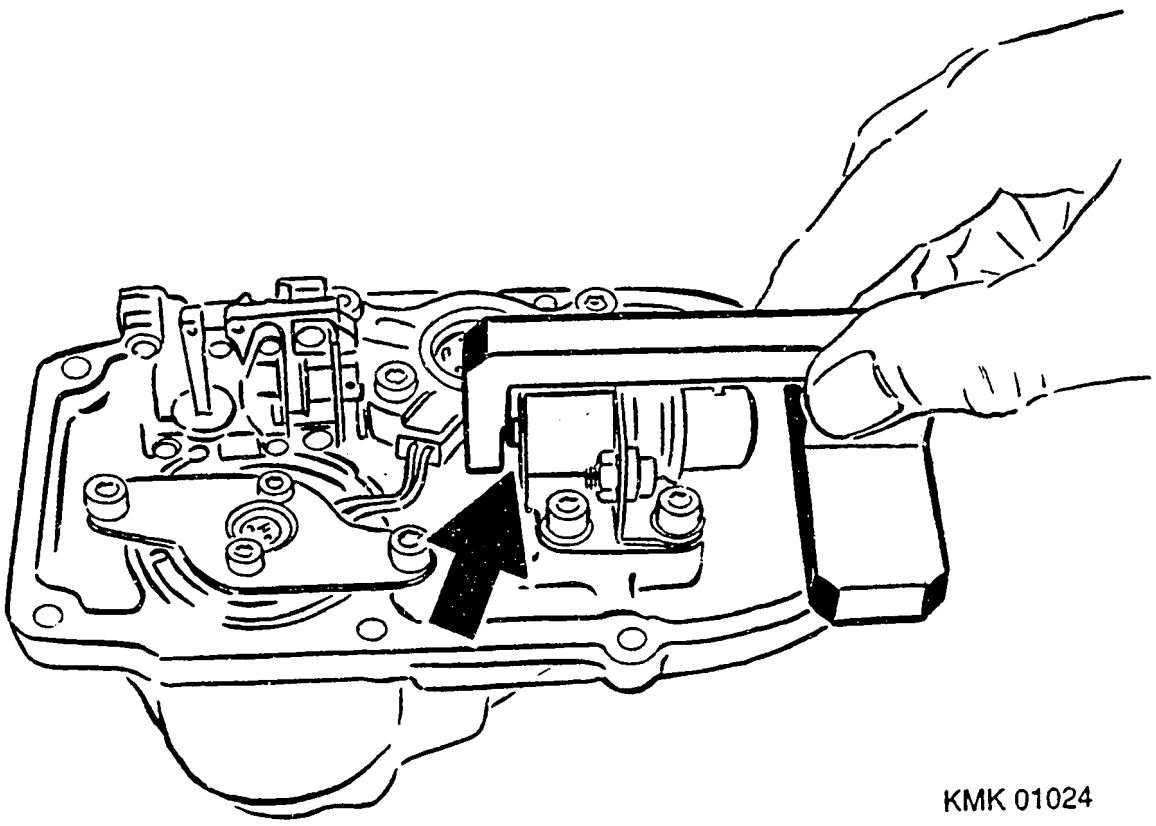
REPAIRING POSITIONER COVER

Adjusting speed sensor:

Place adjustment gauge 0 986 612 301 (KDEP 1701) on positioning pin of positioner cover and screw to cover. Move pulse generator until it makes contact with measurement surface of gauge and tighten screws of backing plate to tightening torque of 8...10 Nm.

Solder leads to pins 3 and 4.
For description of soldering process refer to: D09/1

Continue: C12/1 Fig.: C26/2



KMK 01024

REPAIRING POSITIONER COVER

Replacing 7-pin terminal board:

The following instructions apply both to positioners with housing-fixed round screw connection and to versions with cable bushing and overhung plug. Interior design, hole pattern and position of solder pins are the same for all boards.

Continue: C27/2

REPAIRING POSITIONER COVER

Terminal boards with cable bushing are only available as a complete service part comprising board with cable in correct length, crimped-on contact connector and loose plug components. The replacement of individual plugs is not envisaged, since proper and reliable contact crimping is only possible using the extremely expensive original crimping tools of the plug manufacturers.

Continue: C28/1

REPAIRING POSITIONER COVER

In the course of series production, various vehicle manufacturers have switched from positioners with housing-fixed round screw connection to versions with cable bushing and own plug. In view of the fact that the actual terminal board in the positioner is always the same, the positioner can be appropriately converted without difficulty. It is however to be noted that the positioner part number is to be changed accordingly.

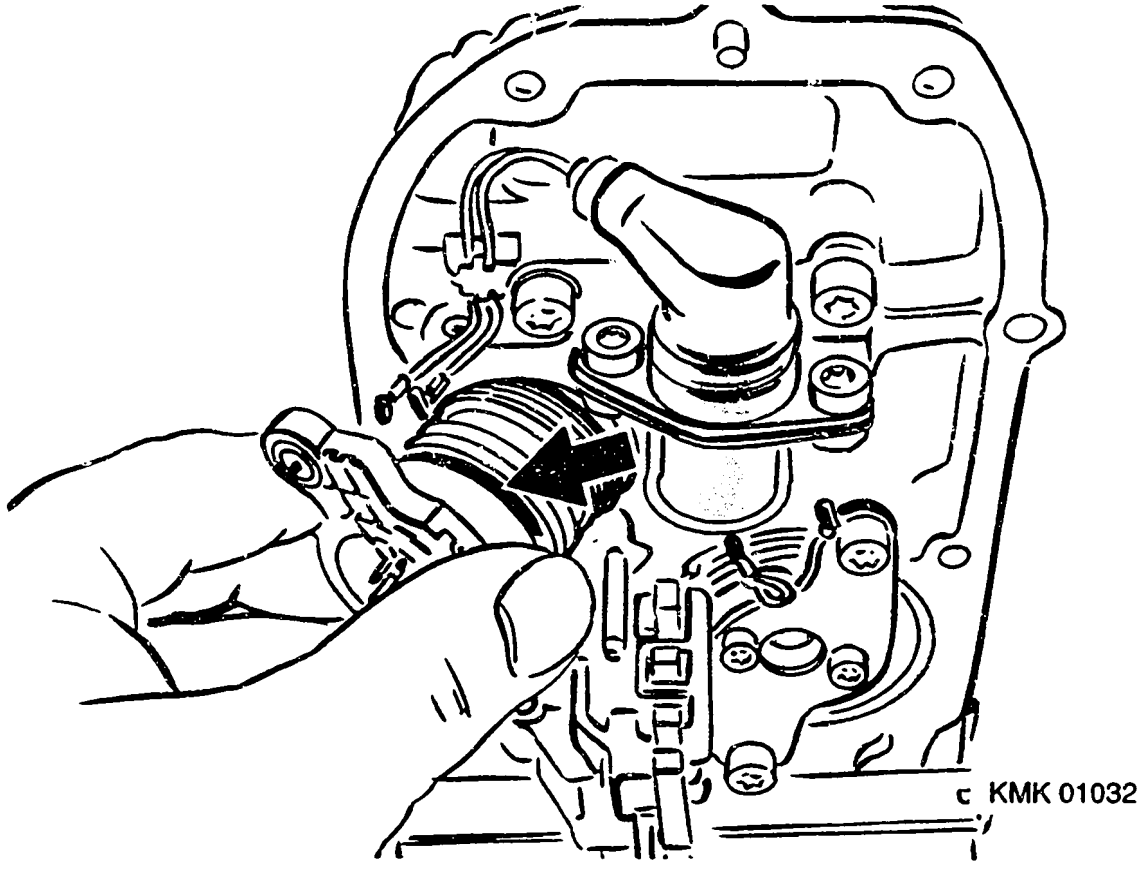
Continue: D01/1

REPAIRING POSITIONER COVER

Replacing terminal board:
Unscrew inner cover plate (3 screws).
In the event of version with cable bushing, cut off cable. Remove insulation molding and unsolder all electrical leads.
For soldering process see coordinate: D09/1

Press terminal board out of positioner.
Insert new terminal board with new O-ring (grease) and align such that holes coincide.

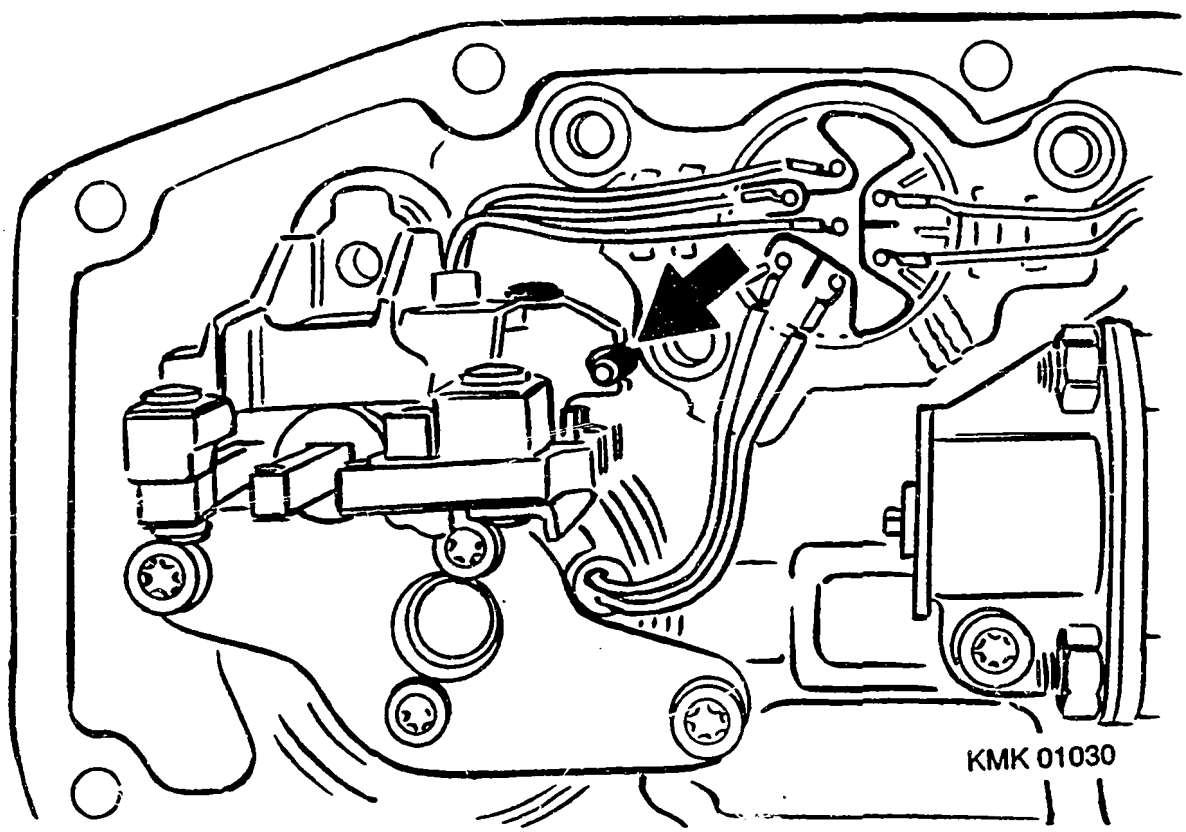
Continue: D02/1 Fig.: D01/2



REPAIRING POSITIONER COVER

Solder component leads to plug pins.
For description of soldering process refer to coordinate: D09/1
Press leads into cable ducts of terminal board. Take care not to damage leads and make sure that they are laid without kinks/tension (see picture).
Mutual contact and contact with moving parts must be precluded. Fit plastic insulating cap even if there was not one present on removal. Fit cover plate; tighten screws to tightening torque of 8...10 Nm.

Continue: D03/1 Fig.: D02/2



REPAIRING POSITIONER COVER

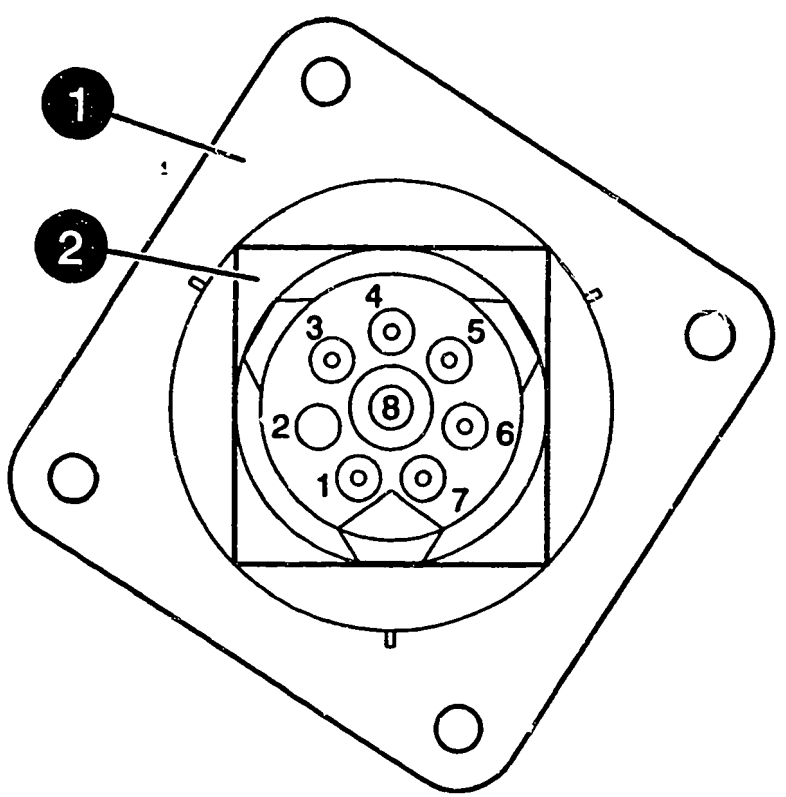
Plug installation for positioner version with cable bushing and Schlemmer plug (e.g. MAN):

Attach flange plate (1) with seal to plug housing (2) and engage such that configuration of encoding and hole pattern are as shown.

Insert contact pins of individual leads into contact pin sockets in plug housing in line with following coordinate.

Continue: D04/1 Fig.: D03/2

KMK04482



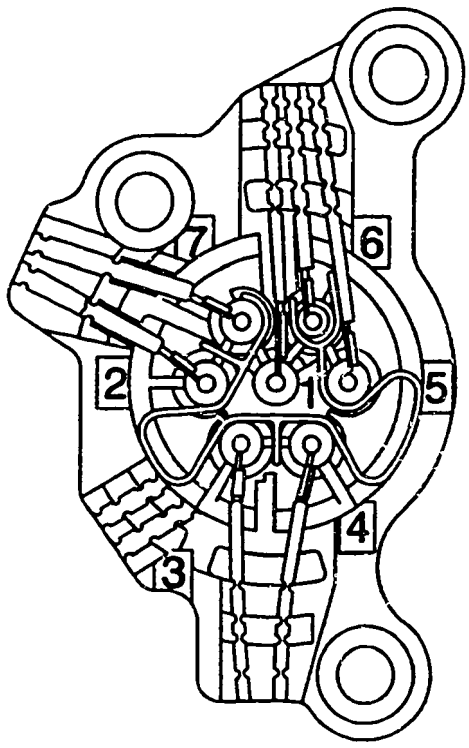
REPAIRING POSITIONER COVER

Plug assignment: Schlemmer plug
and positioner terminal board:

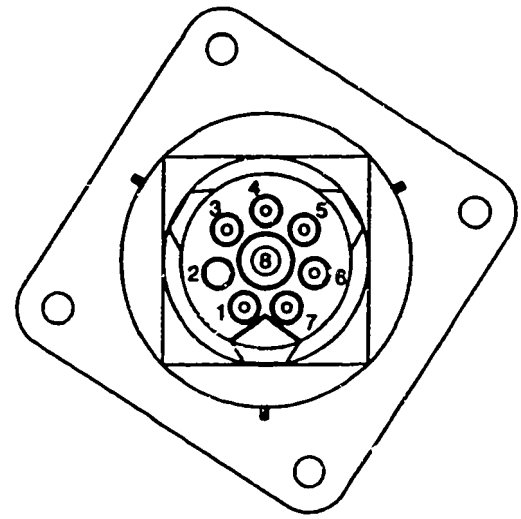
Schlemmer plug	Lead color	Positioner solder pin
1	green	1
2=not used	—	—
3	blue	3
4	white	4
5	black	5
6	red	6
7	brown (small)	7
8	brown (large)	2

Always use ohmmeter to recheck
proper connection.

Continue: D05/1 Fig.: D04/2



KMK04478

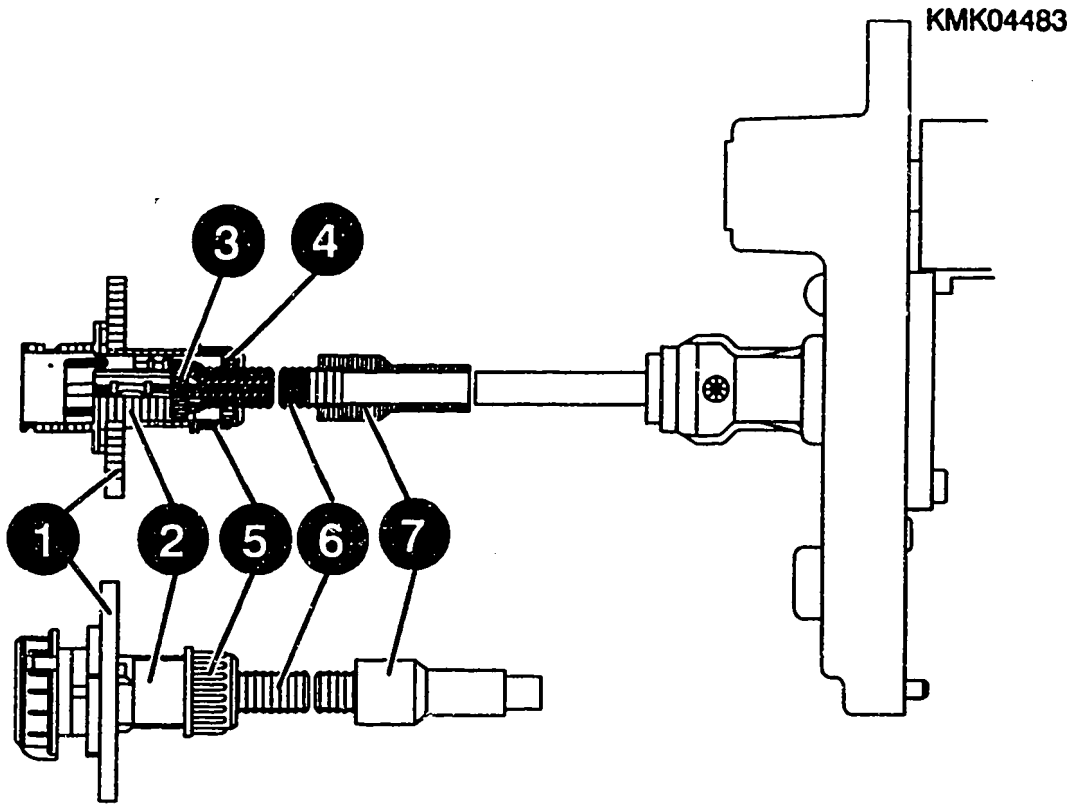


REPAIRING POSITIONER COVER

Plug attachment – Schlemmer plug:

Insert core sealing plate (3) in plug housing. Position ring seal (4) on corrugated tube (6) such that two grooves are free in front of seal. Insert corrugated tube in housing, screw on and tighten cap nut (5). Slip half length of shrink-down tubing (7) onto corrugated tube and shrink down with hot-air blower until contact is made with corrugated tube and cable.

Continue: D06/1 Fig.: D05/2



REPAIRING POSITIONER COVER

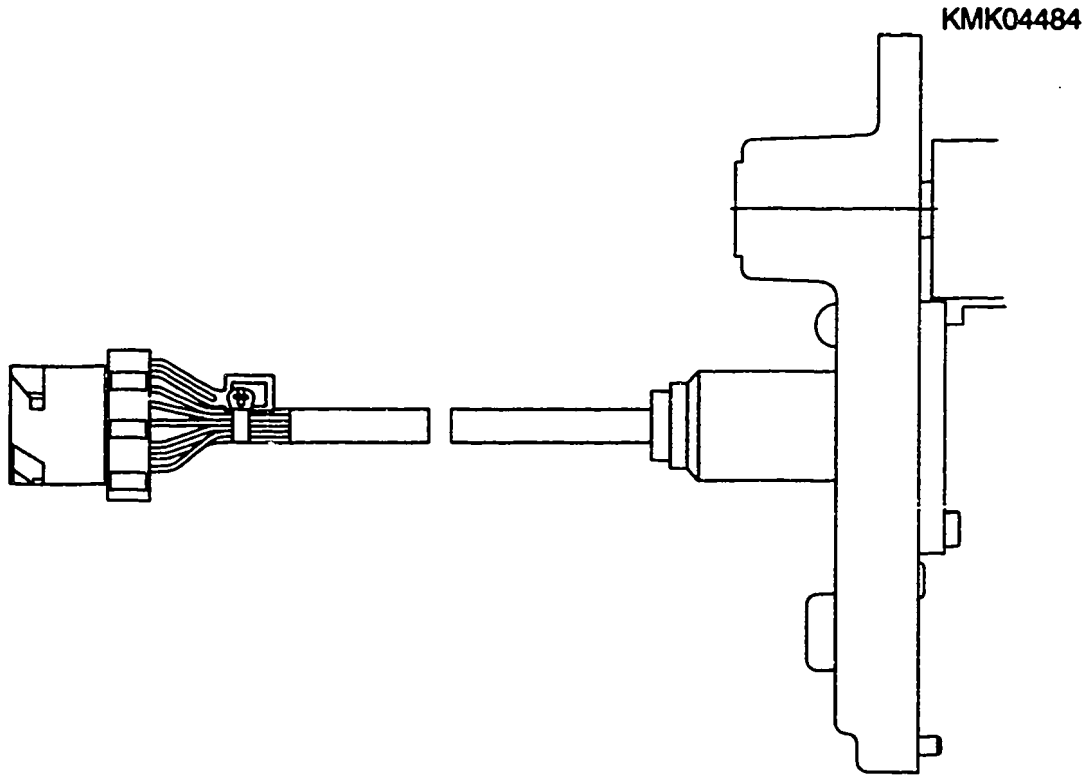
Plug installation for positioner version with cable bushing and Deutsch plug (e.g. Mack):

Slip cap nut over cable.

Insert contact pins of individual leads into contact pin sockets in plug housing in line with following coordinate.

Make sure that pins engage (try pulling on them).

Continue: D07/1 Fig.: D06/2



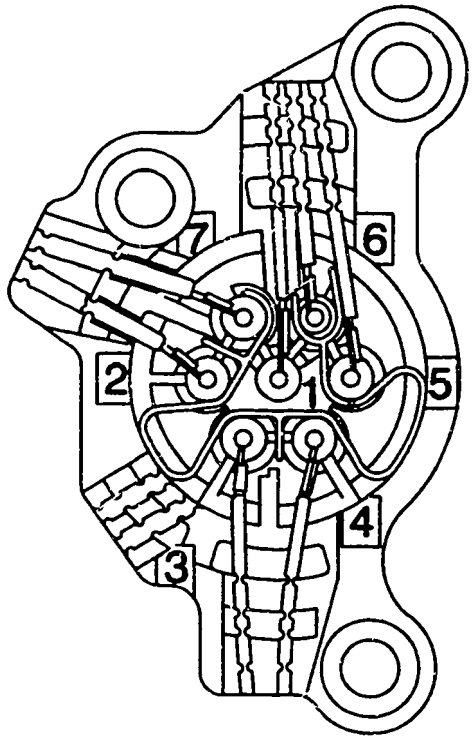
REPAIRING POSITIONER COVER

Plug assignment – Deutsch plug and positioner terminal board:

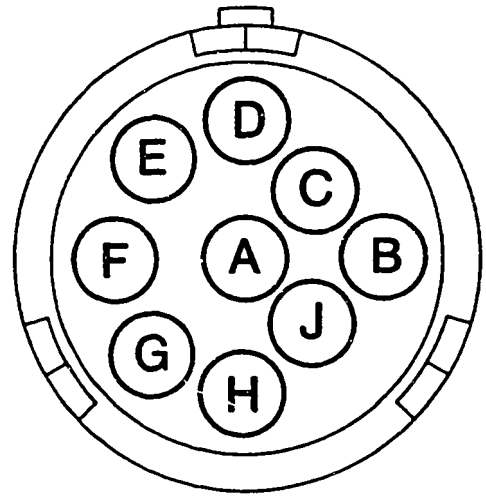
Deutsch plug	Lead color	Positioner solder pin
A	green	1
B	brown	2
C	blue	3
D	white	4
E	black	5
F	red	6
G	brown	7
H, J = not used	—	–

Use ohmmeter to determine assignment of brown leads. Always recheck overall assignment.

Continue: D08/1 Fig.: D07/2



KMK04479



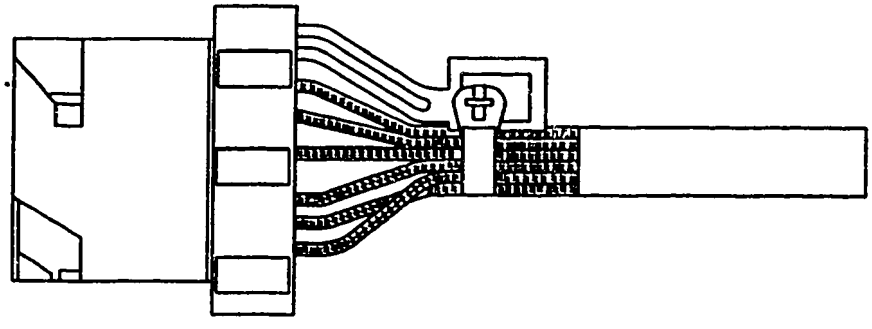
REPAIRING POSITIONER COVER

Plug attachment – Deutsch plug:

Screw cap nut to plug housing and tighten firmly.
Bunch individual leads and attach to tab of cap nut with tie band. Secure tie band firmly.

Continue: C12/1 Fig.: D08/2

KMKC4485



REPAIRING POSITIONER COVER

Soldering specification for leads on 7-pin terminal board:

Proper soldering of the leads to the terminal board is an essential pre-requisite for proper, long-term functioning of the RE positioner. Soldering should be implemented such that contact resistance or breakage of connections caused by the consider-able acceleration due to vibration at the positioner is reliably avoided. The work described in the following is thus to be performed with extreme care.

Continue: D09/2

REPAIRING POSITIONER COVER

Demands made of soldering equipment:

* Temperature-regulated soldering iron
  - Soldering tip temperature 350... 370 degrees C, power approx. 50 W

  Recommendation:
  - Weller soldering station WTCP-S with
  - soldering iron TCP-S 24 V, 50 W
  - Soldering tip No. 7, long, tapered, 370 degrees C
* Soldering tin: With no bismuth or calcium
  e.g. DIN Sn60 Pb Cu2 or Sn63 Pb
* Recommended flux (solder cream):
  DIN F-SW 26 (2.5 %) or
  in USA: Type RMA 2...3 % QQ-S-571

Continue: D10/1

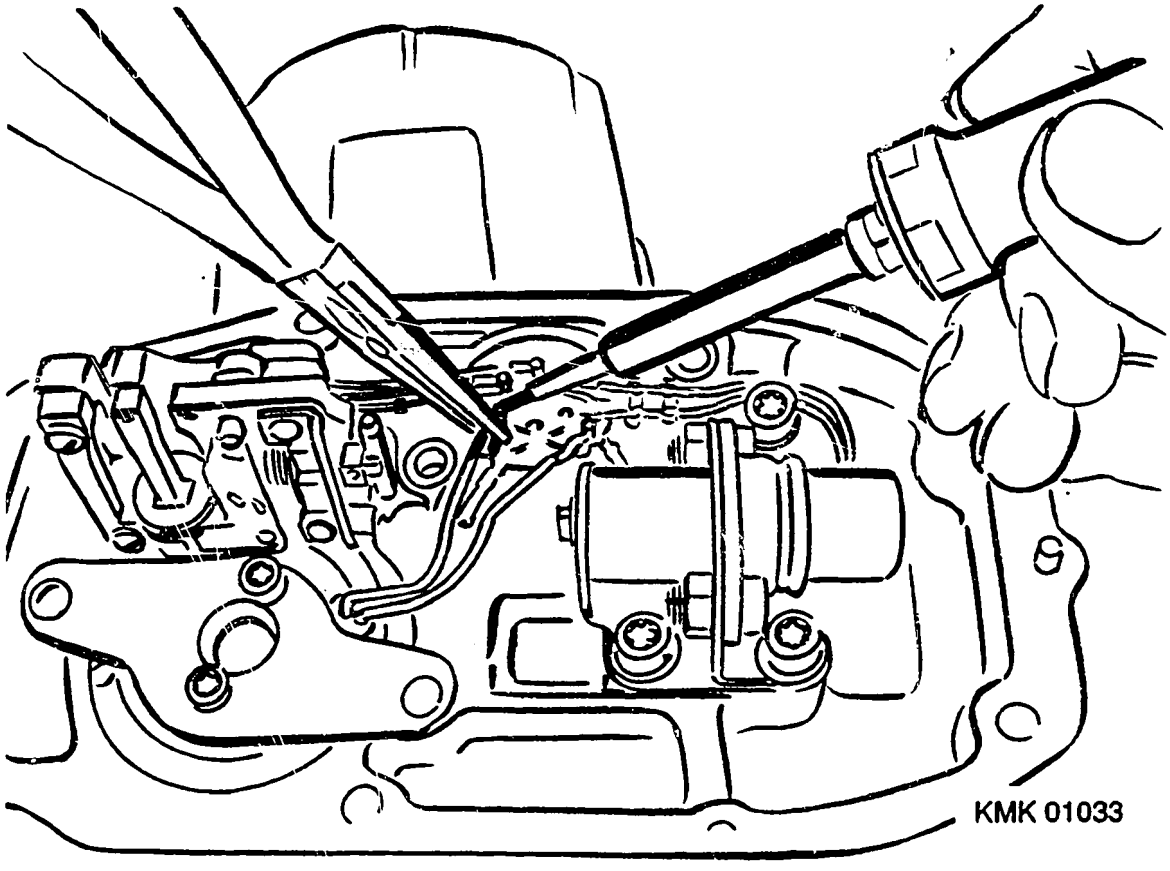
REPAIRING POSITIONER COVER

Soldering process:

Unscrew cover plate of 7-pin terminal board (3 screws) to provide access to contact pins.
If fitted, remove plastic insulating cap from plug board.

Clean solder connections of component concerned (e.g. with acetone).
Hold soldering iron against side of soldering eye until soldering tin is liquid and pull soldering eye off contact pin using small pointed pliers.
Attention: Take care not to bend contact pins (pre-damage).

Continue: D11/1 Fig.: D10/2



REPAIRING POSITIONER COVER

New components are supplied with leads of correct length and with crimped-on soldering eyes. Alterations to the leads are not permitted.

If a new plug plate is fitted, the contact pins are to be cleaned mechanically (fine sandpaper) and with a cleaning agent (e.g. acetone) in the area to be soldered and then pre-tinned.

Continue: D12/1

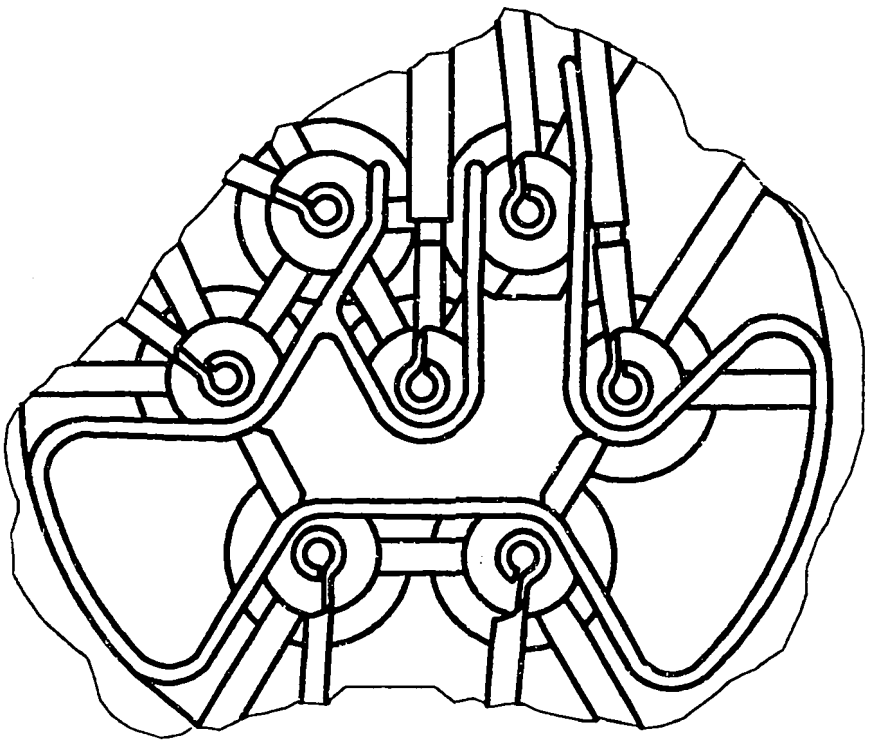
REPAIRING POSITIONER COVER

Installation position of soldering eyes:

Attach soldering eyes to contact pins such that opening in eye is always on left (refer to picture). Properly align eye. Eye, crimp and lead must be in alignment.

A small amount of solder cream can be applied to the contact pins. Attach new eyes flush with contact pin. Heat eye on the side until soldering tin is drawn in. Place re-useable soldering eyes in position, heat until soldering tin is liquid, and then press down.

Continue: D13/1 Fig.: D12/2



KMK01034

REPAIRING POSITIONER COVER

Important: Do not apply too much soldering tin. There must be no soldering tin on the soldering eye in the area of the crimp, so as to maintain the flexibility of the lead.

Refer to the following Coordinate for assignment of component and lead colors to contact pins.

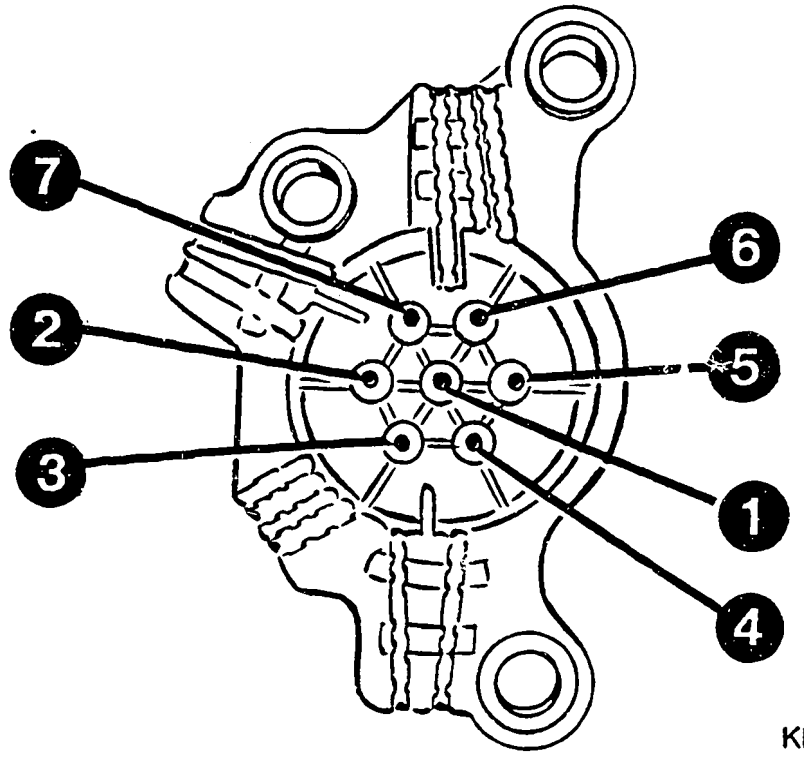
Continue: D14/1

REPAIRING POSITIONER COVER

Assignment of components and lead colors to contact pins (picture): (pin numbers are embossed on new terminal boards).

Component	Color	Contact pin
Servo-magnet	black	2
Servo-magnet	black	7
RPS	green	1
RPS	black	5
RPS	red	6
Speed pulse generator	black	3
Speed pulse generator	red	4

Continue: D15/1 Fig.: D14/2



KMK 01035

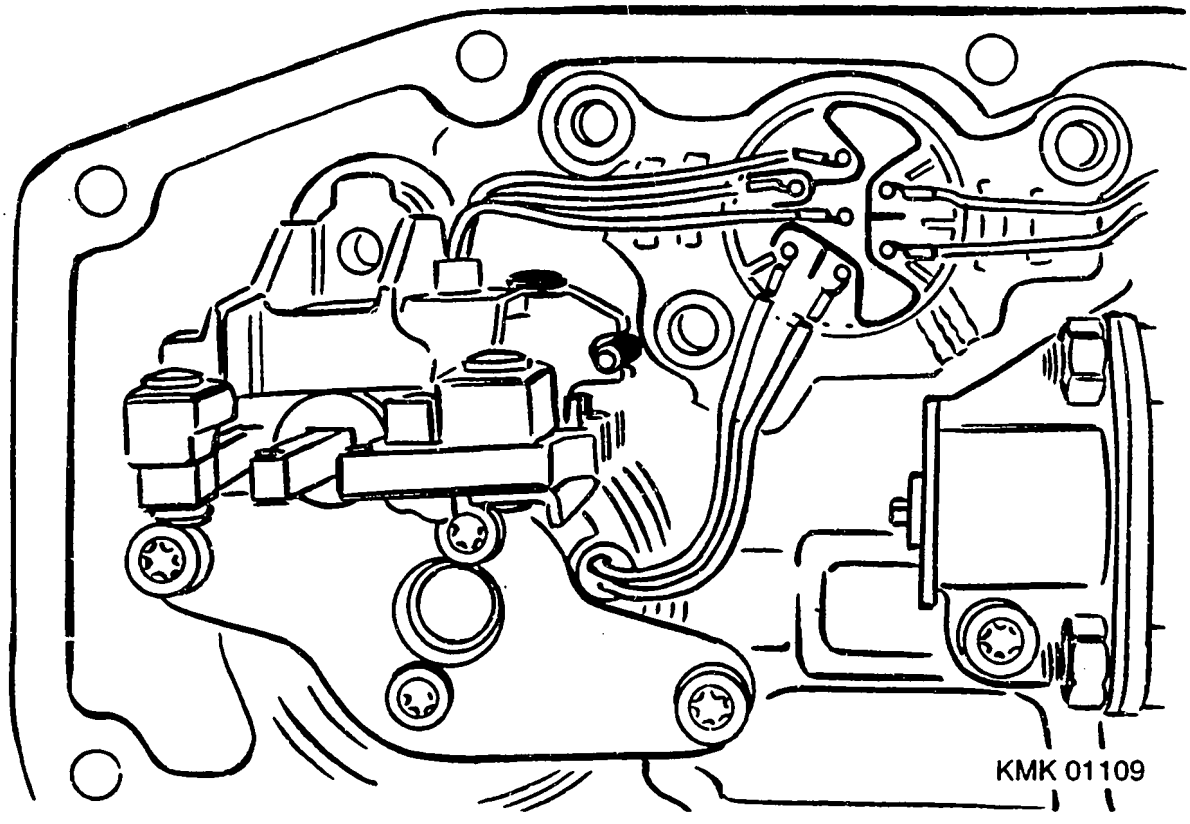
REPAIRING POSITIONER COVER

Laying of leads:

Once the leads have been soldered on, insert them in cable ducts of terminal board.

The further routing of the leads should be as shown in the picture. It must be ensured that the leads do not have mutual contact, that there are no kinks, that there is no stress and that the leads do not come into contact with moving parts.

Continue: D16/1 Fig.: D15/2

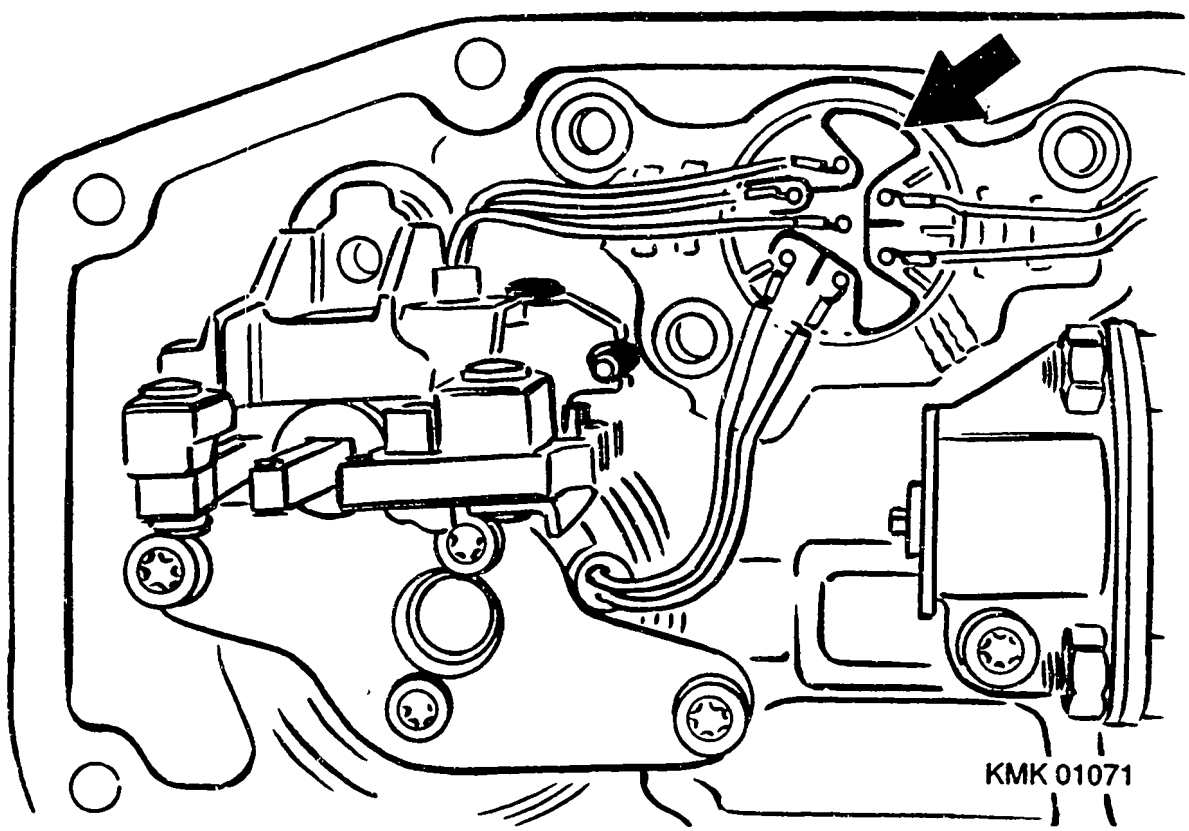


REPAIRING POSITIONER COVER

Plastic insulating cap (picture):

This molding is designed such that there is a separate recess for each contact pin in the terminal board.
This cap is always to be inserted in the terminal board when soldering work has been completed.
The cap should likewise be retro-fitted on old positioners without this feature.
As a final step, fit cover plate and tighten fastening screws to tightening torque of 8...10 Nm.

Continue: N27/2 Fig.: D16/2



POSITIONER ASSEMBLY

Attachment of positioner housing to fuel-injection-pump housing:

Note: With the RE 24 positioner, attachment of the housing to the fuel-injection pump is part of pump assembly (setting of camshaft projection, microcard, see list W-400/00.).

Continue: D17/2

POSITIONER ASSEMBLY

The original housing fastening screws are micro-encapsulated for self-locking purposes. The micro-encapsulation may become ineffective as soon as the screw has been screwed out once (screw can be turned too easily).
The following procedure is therefore to be adopted:

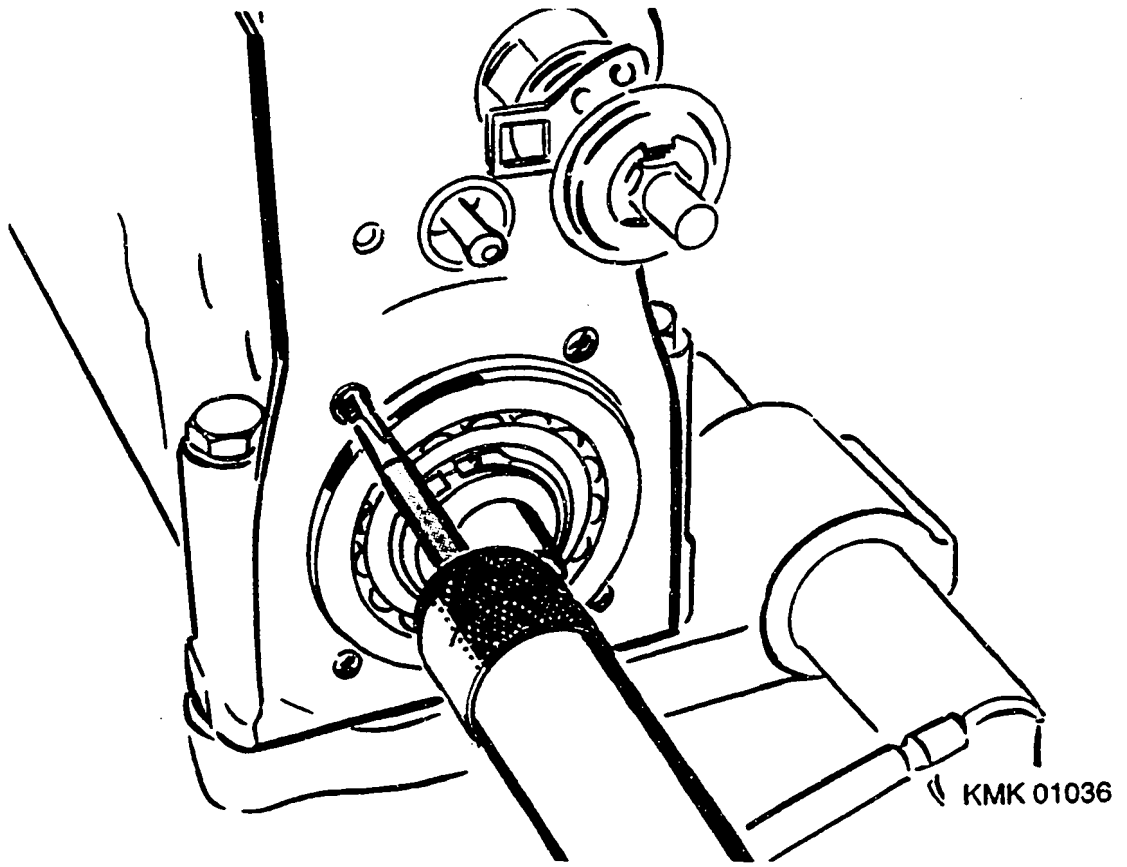
Continue: D18/1

POSITIONER ASSEMBLY

Clean tapped holes in pump housing with M 6 tap and blow out with compressed air. The holes should be free from dirt and oil residue.

Likewise clean threads of screws with wire brush.
Note: The micro-encapsulation is also to be removed with a wire brush in the case of new screws, if they have been in storage for more than 1 year.
The maximum storage period for micro-encapsulated screws is 1 year; after this period the micro-encapsulation becomes too hard.

Continue: D19/1 Fig.: D18/2

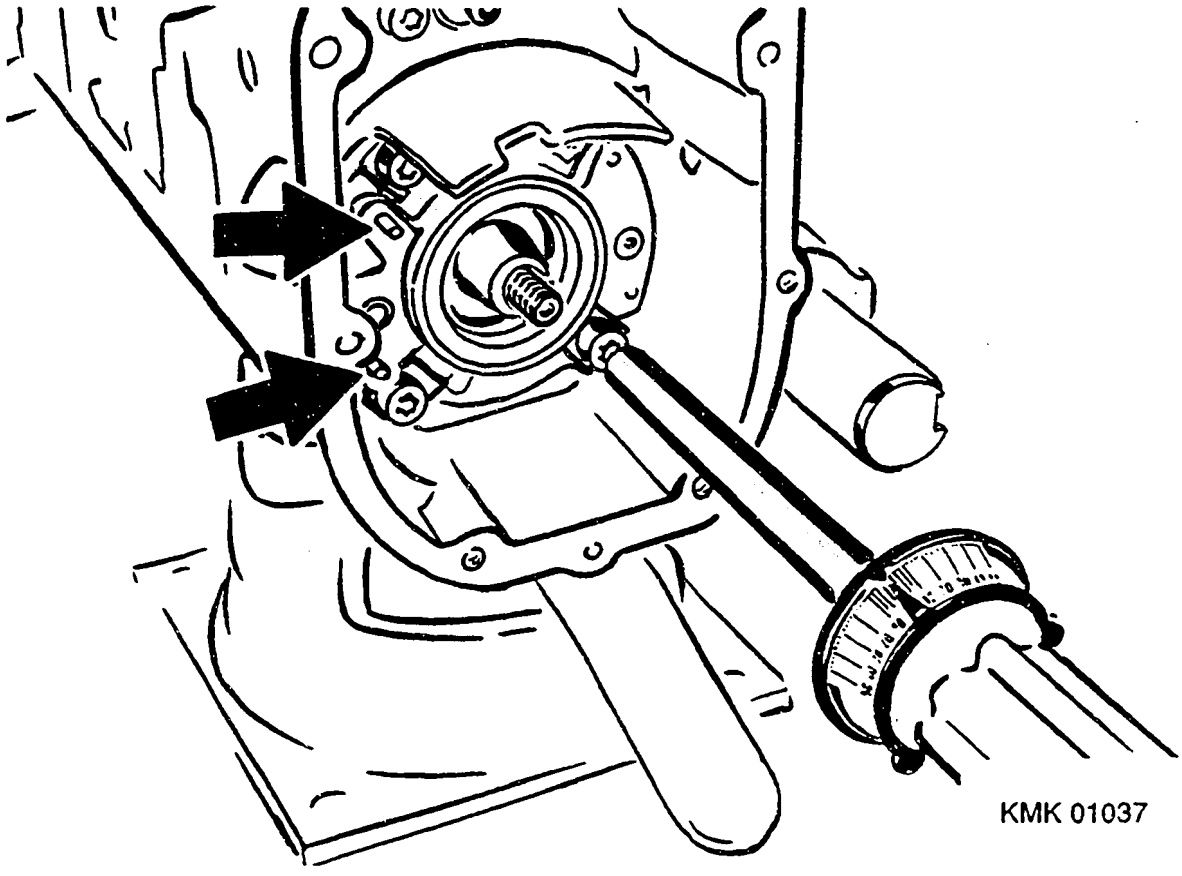


POSITIONER ASSEMBLY

Fit positioner housing with shim (RE 24) or with intermediate flange (RE 30).
Pay attention to correct position of intermediate flange in line with direction of rotation of pump. On viewing housing from the top, the two guide pins for the oil pump (arrows) are on the left for fuel-injection pumps with counter-clockwise rotation and on the right for pumps with clockwise rotation.

Apply small quantity of Loctite 242 screw locking compound to threads of fastening screws, screw in and tighten to tightening torque of 7...9 Nm.

Continue: D20/1 Fig.: D19/2

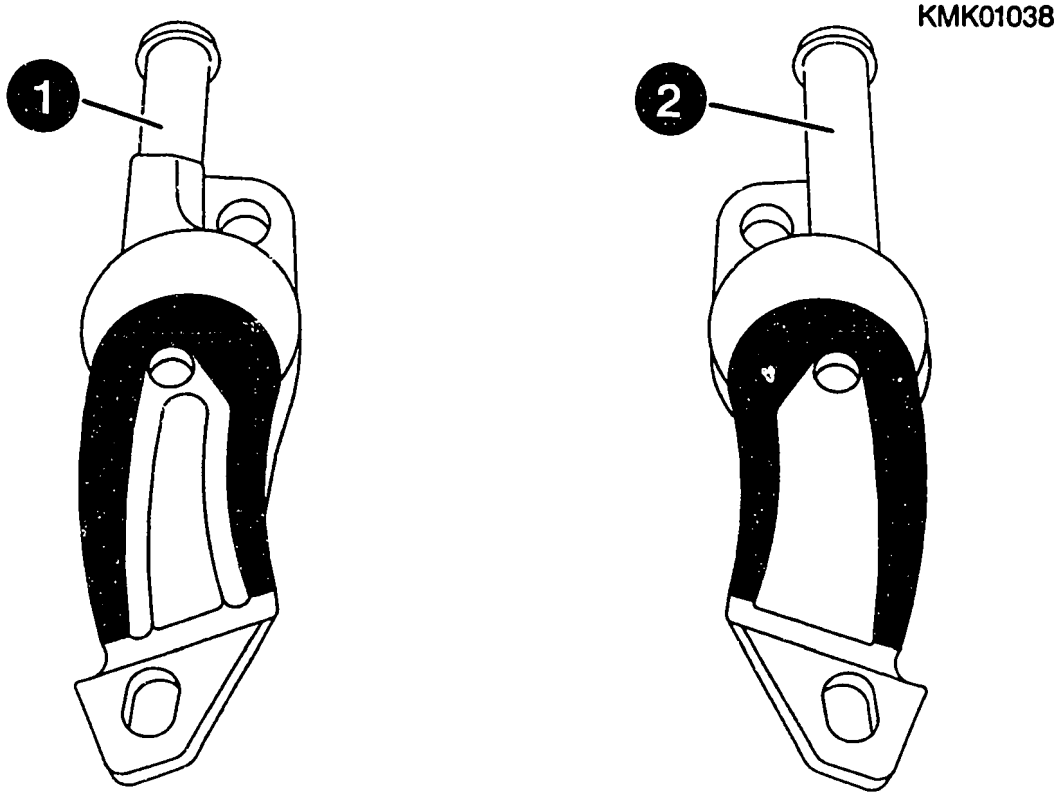


POSITIONER ASSEMBLY

Installation of oil pump and speed-sensor pulse wheel:
Pulse wheel: Ensure that correct pulse wheel is fitted. The number of pulse vanes must correspond to twice the number of fuel-injection-pump barrels.
Oil pump: Depending on direction of rotation, there are two different oil pumps with opposing housing curvature: Fitted on the left for counter-clockwise (Fig. 1) as viewed from pulse-wheel end and fitted on the right for clockwise (Fig. 2). The oil hoses likewise differ and do not fit the wrong version.

Continue: D21/1 Fig.: D20/2

KMK01038

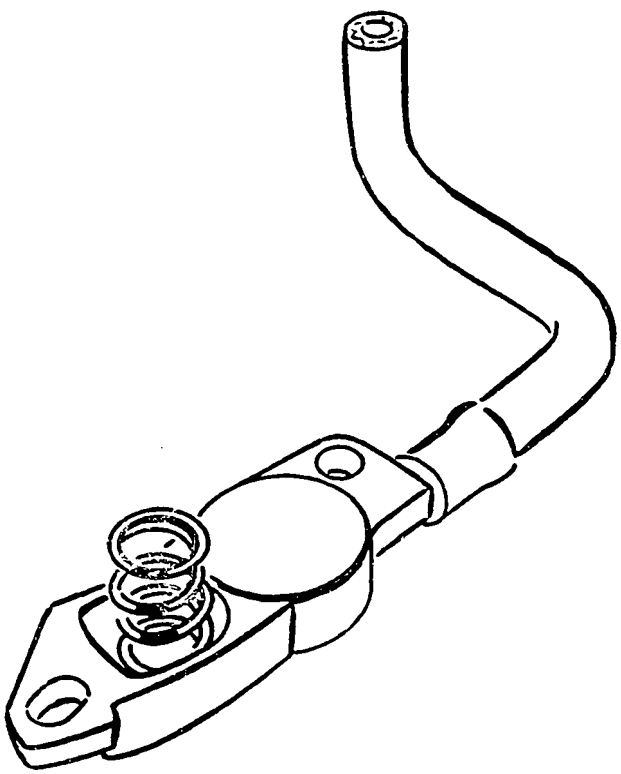


POSITIONER ASSEMBLY

Important note: Use cleaning agent to thoroughly clean taper of camshaft, tapered bore in pulse wheel and pulse-wheel fastening nut. After cleaning, the parts must be absolutely free of grease and completely dry.

Insert spring of oil pump in holder on back of pump - bond in with small amount of hot bearing grease.

Continue: D22/1 Fig.: D21/2



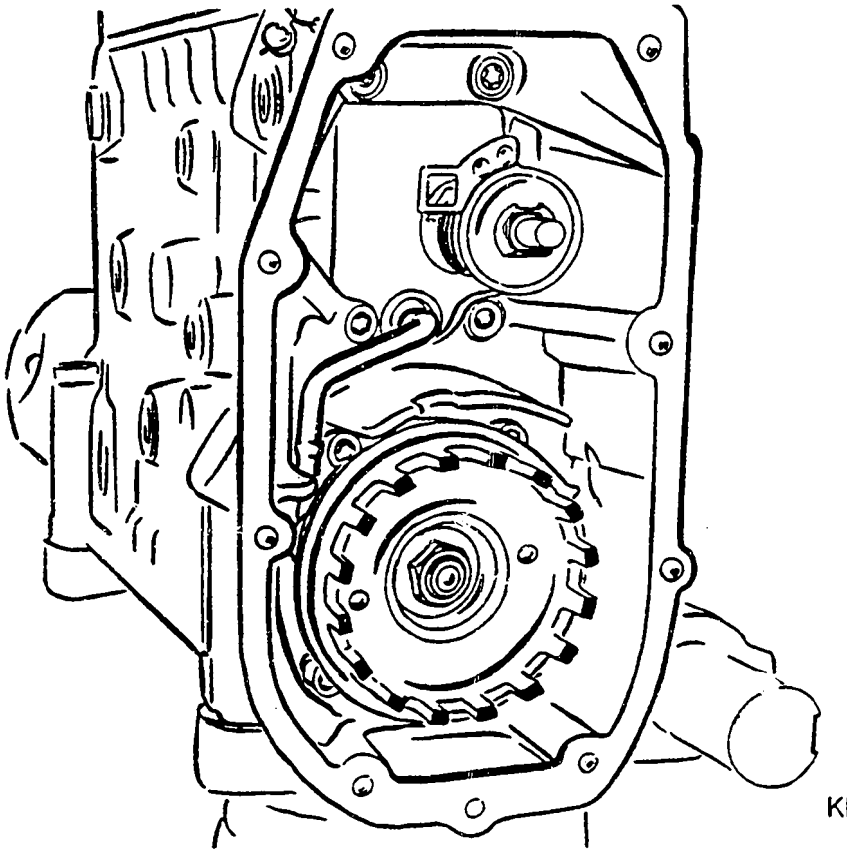
KMK 01039

POSITIONER ASSEMBLY

Install oil pump with spring. It must be possible to move it easily on the two guide pins against spring force.

Hold oil pump (if applicable with plastic pin – tool must not be allowed to come into contact with bearing surface). Slip pulse wheel onto taper of camshaft and hold. Screw on nut and tighten slightly such that pulse wheel is fixed without play, but can be loosened again and turned on the taper without an extractor.

Continue: D23/1 Fig.: D22/2



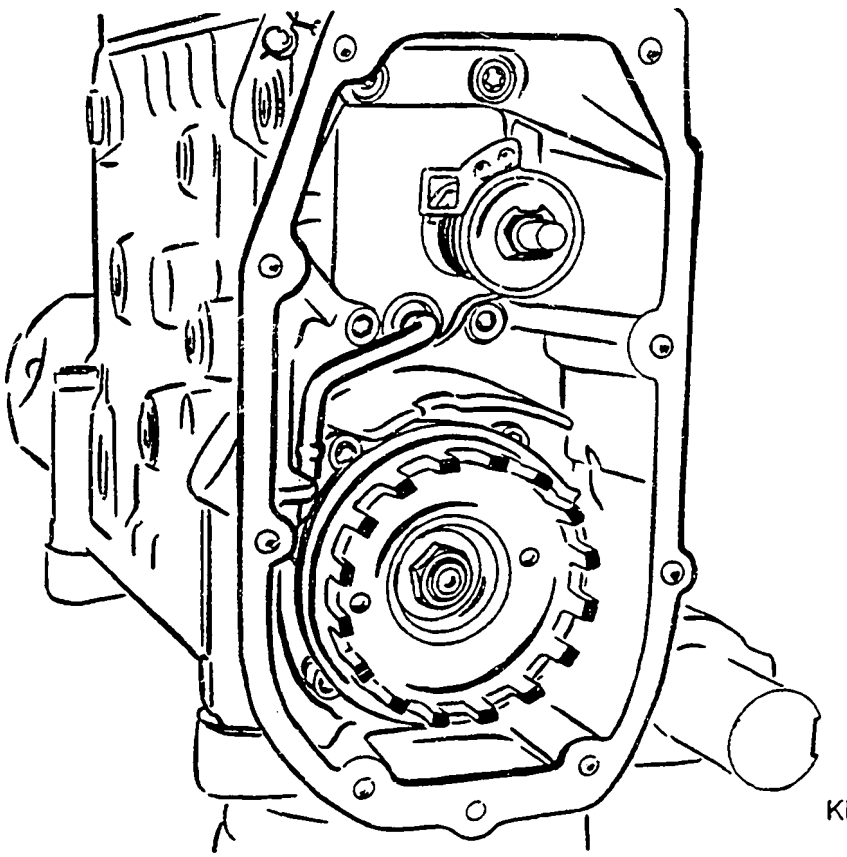
KMK 01011

POSITIONER ASSEMBLY

Check whether spring force presses oil pump against pulse wheel.

Slip hose such that there is no stress as far as it will go onto connection of oil pump and connection in pump housing.

Continue: D24/1 Fig.: D23/2



KMK 01011

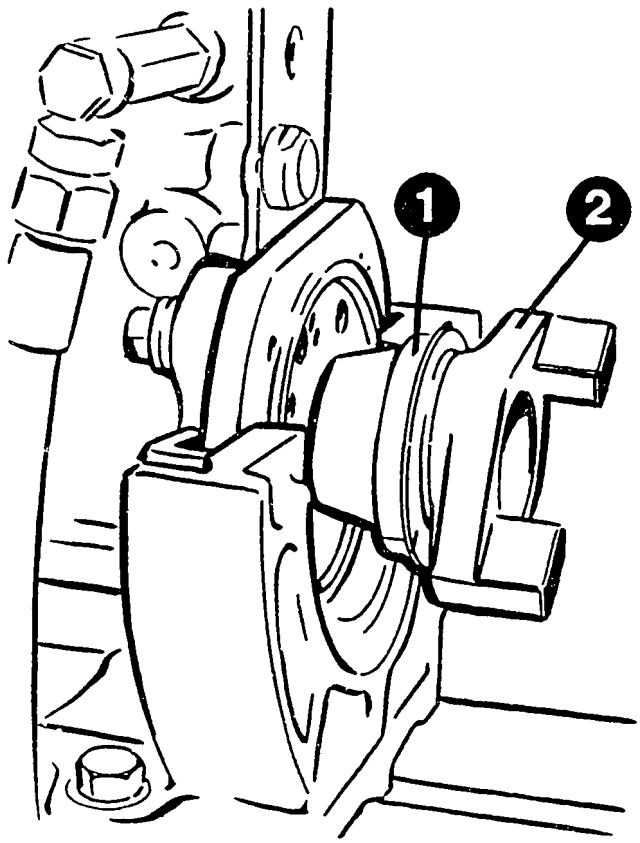
POSITIONER ASSEMBLY

Attach two-claw drive coupling (2) with shim (1) of camshaft blocking device 0 986 612 056 (KDEP 1545) to fuel-injection pump.
Shim as per coupling:

0 986 612 356 (KDEP 1737) = taper 30 mm
0 986 612 254 (KDEP 1630) = taper 35 mm

Attach fuel-injection pump to pump test bench in line with existing documentation for P-pumps. Calibrating nozzle-holder assemblies and calibrating oil lines are not to be connected up for the purpose of the following operations.

Continue: D25/1 Fig.: D24/2

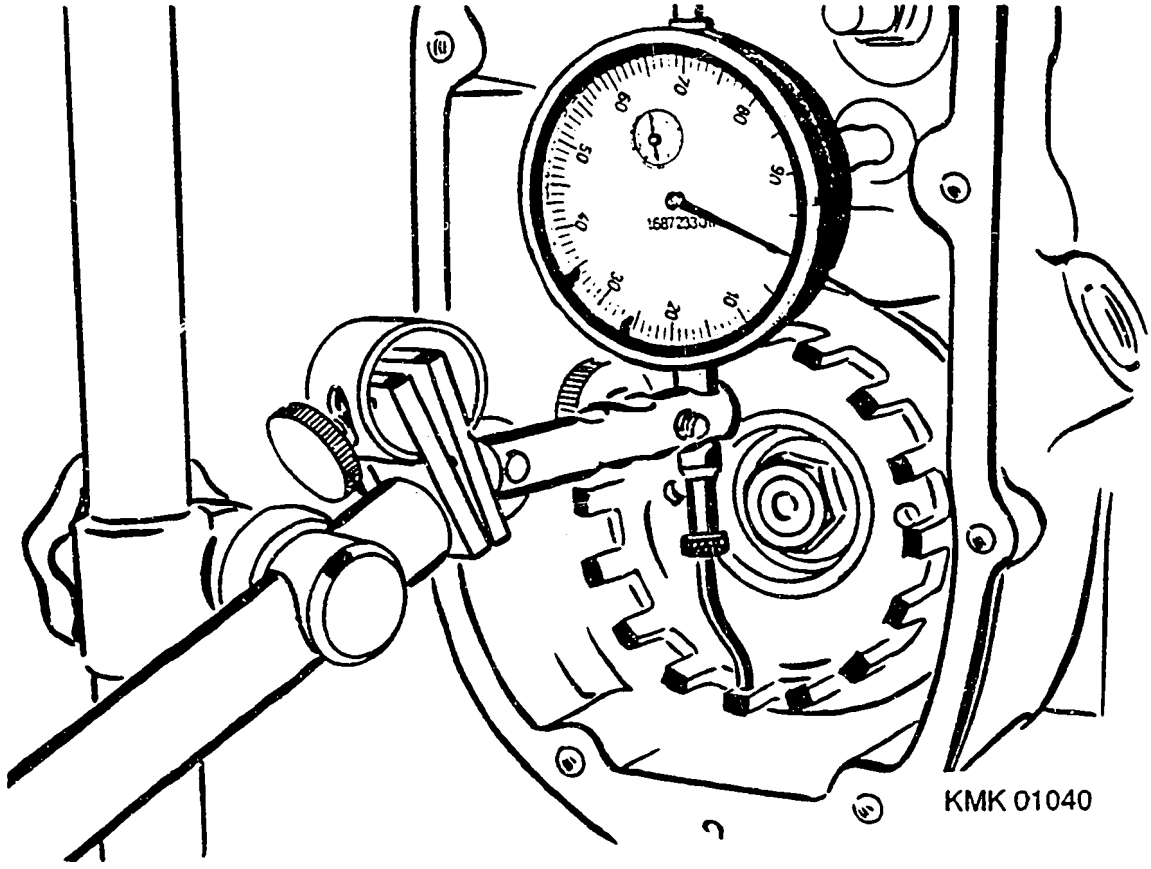


KMK 00493

POSITIONER ASSEMBLY

Checking eccentricity of pulse wheel vanes (inner):
Perform test with commercially available measurement stand (e.g. Bosch 4 851 601 124) and dial indicator (graduation 0.01 mm, e.g. Bosch 1 687 233 011) and offset base (commercially available or Bosch 0 986 611 546 (KDEP 1023/0/6) with lock nut 0 986 611 547 (KDEP 1023/0/7).
Position stand with dial indicator on test-bench clamping rail and check inside position of each vane of pulse wheel. Eccentricity:
From vane to vane : max. 0.03 mm
Over one revolution : max. 0.10 mm

Continue: D26/1 Fig.: D25/2



POSITIONER ASSEMBLY

The pulse wheel is to be scrapped in
the event of excessive deviation.
Note:
Bent vanes are not to be dressed!
The vane may subsequently break, thus
resulting in incorrect speed evaluation
and the possibility of engine damage.

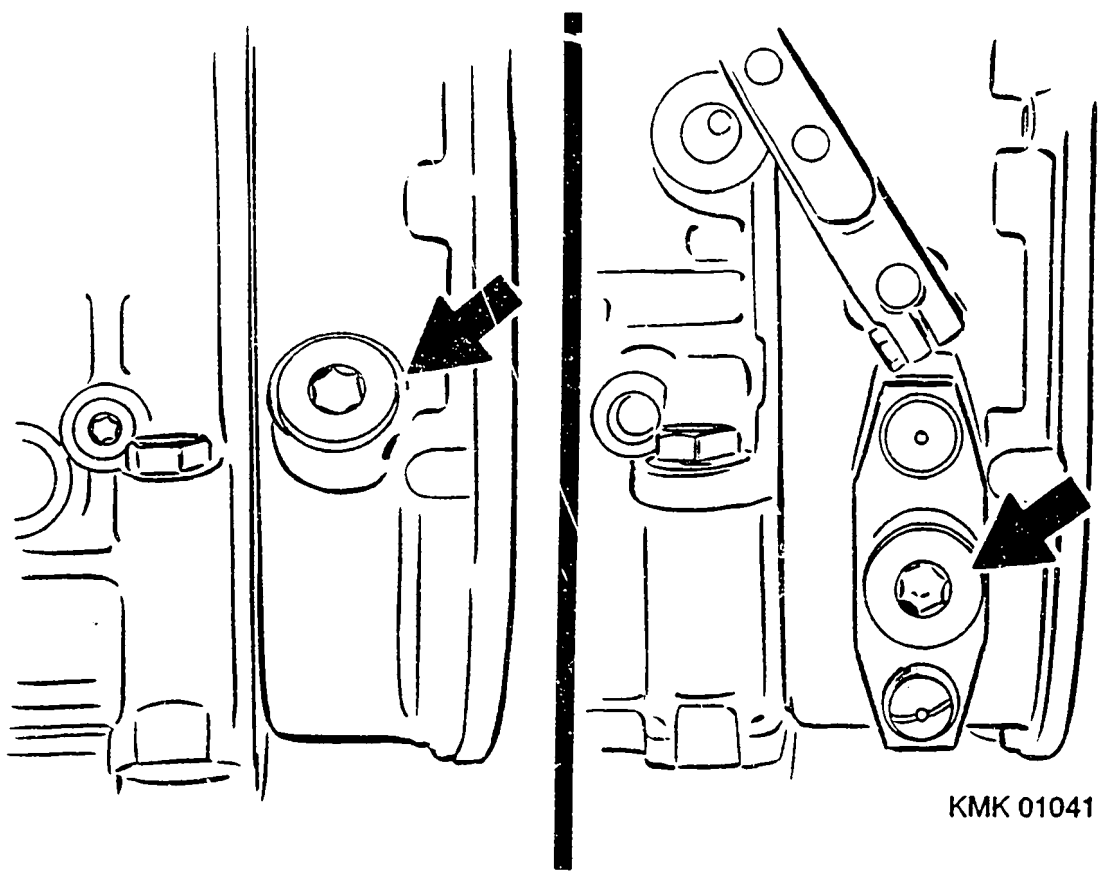
Continue: D27/1

POSITIONER ASSEMBLY

Adjusting position of pulse wheel (start-of-delivery cam):

Depending on positioner design, there is a fixed (angled) start-of-delivery adjustment hole (arrows) in the positioner housing or a lateral adjusting flange with the adjustment hole. Adjustment of the pulse-wheel position is the same for both versions, however the dimension "Y" is to be set beforehand with the adjusting-flange. Is the positioner version concerned one without adjusting flange?

Yes: E05/1 No: D28/1 Fig.: D27/2



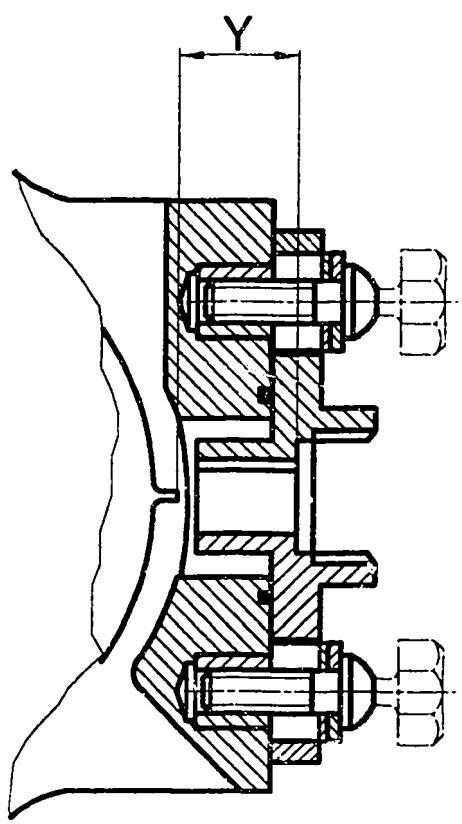
KMK 01041

POSITIONER ASSEMBLY

Positioner version with sliding flange:
The sliding flange is secured with break-off screws (in some cases one break-off screw and one hexagon bolt) and is only to be unscrewed if the dimension "Y" (distance between inner collar and start-of-delivery cam of speed-sensor pulse wheel) is not correct.

Dimension "Y" test specification and setting are given in test specification sheet.
Dimension "Y" can be corrected by changing sliding flange (flanges have different dimensions).

Continue: E01/1 Fig.: D28/2



KMK01042

POSITIONER ASSEMBLY

Note: Start-of-delivery cam of pulse wheel and hole in sliding flange serve the following purpose (depending on engine manufacturer's specifications):
- Static or dynamic testing of start of delivery (assignment of fuel-injection pump to engine).
- Testing timing-device function.
- Positioning camshaft in start-of-delivery position for attachment of fuel-injection pump to engine (plug-type blocking pin in screw plug).

In normal engine operation, the hole is sealed with a screw plug.

Continue: E01/2

POSITIONER ASSEMBLY

The application-induced tolerance for the dimension "Y" can be set by choosing from a group of 2 sliding flanges (part numbers 1 425 703 012 and ..C13).

Exception: With certain engine manufacturers (e.g. Mack/USA) the sliding flange serves to accommodate a reference-mark sensor for regulating the start of injection. The resultant tighter tolerance for the dimension "Y" (see test specification sheet) means extending the selection group to 5 sliding flanges (see appropriate service parts list).

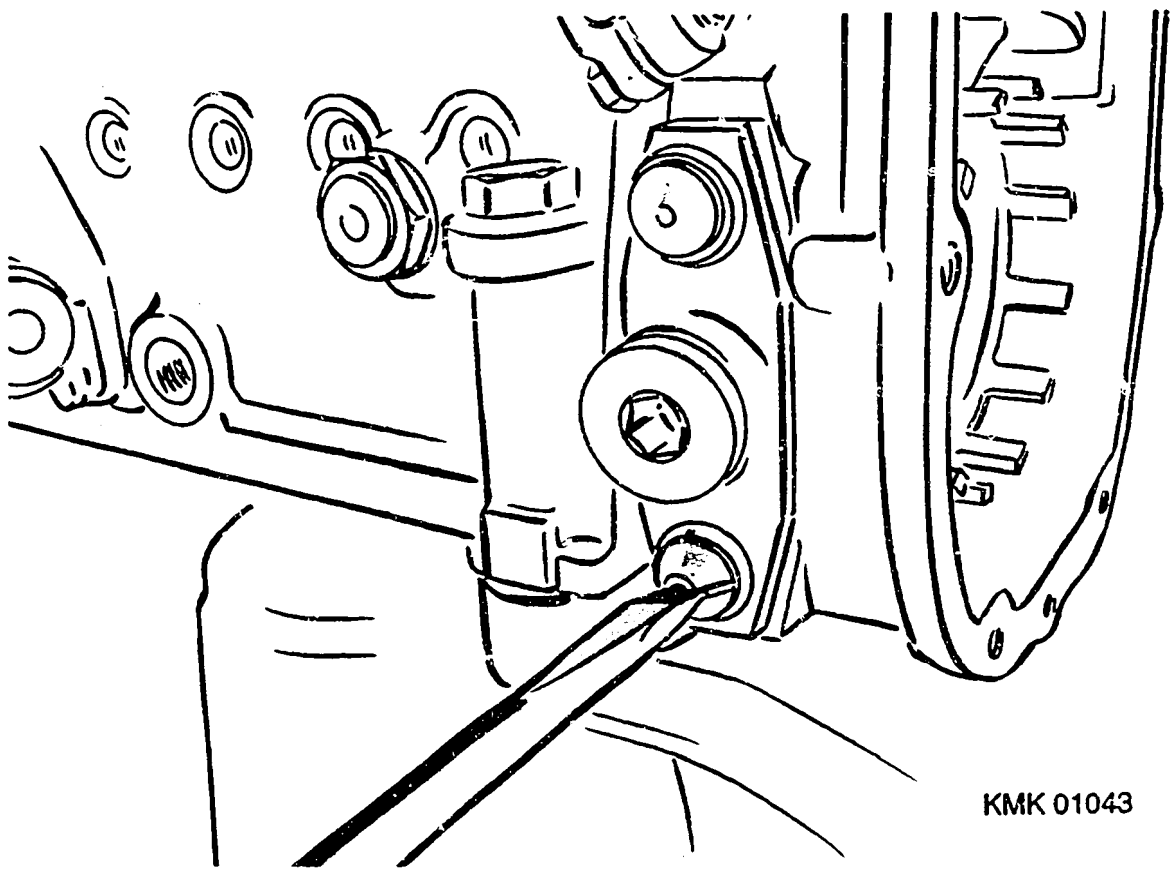
Continue: E02/1

POSITIONER ASSEMBLY

Replacement of adjusting flange:

Saw slot in break-off screws and screw off with screwdriver. Fit new adjusting flange with new seal such that tapped holes are centered with the slots. Slightly tighten new break-off screws; do not break off.

Continue: E03/1 Fig.: E02/2

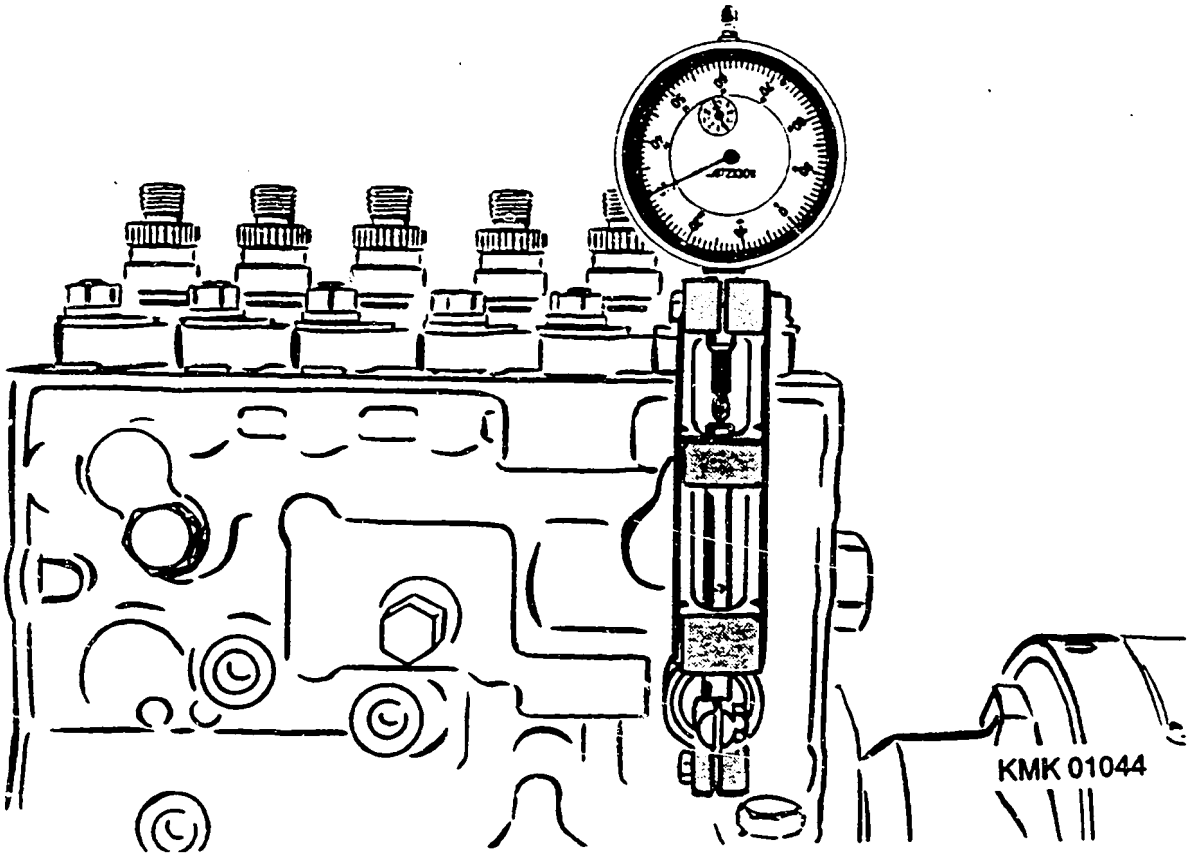


POSITIONER ASSEMBLY

Attach prestroke measuring device 1 688 130 112 with dial indicator 1 687 233 012 to start-of-delivery adjusting barrel of fuel-injection pump. Set prestroke exactly to mean value indicated in test-specification sheet.

Turn camshaft in accordance with graduated scale on test-bench fly-wheel to pulse-wheel position as shown in test-specification sheet.

Continue: E04/1 Fig.: E03/2

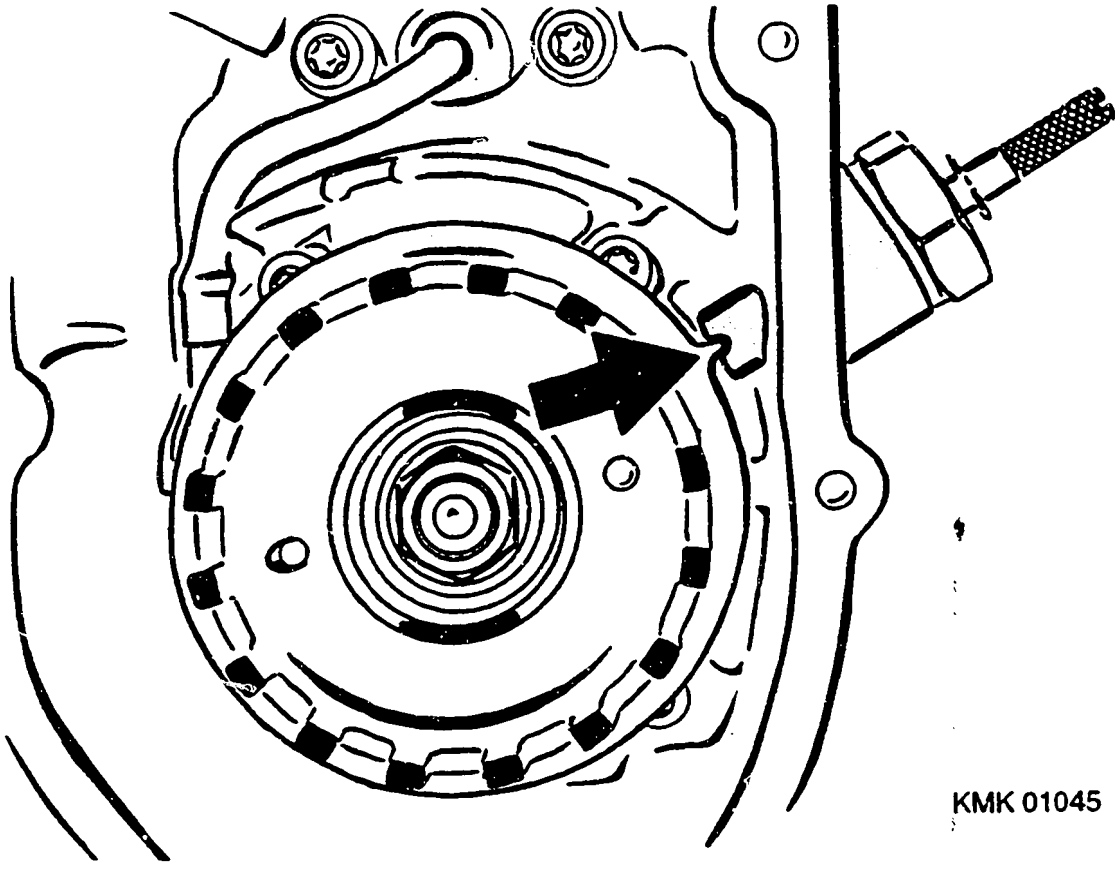


POSITIONER ASSEMBLY

By turning pulse wheel, cause start-of-delivery adjusting cam to coincide with start-of-delivery adjustment bore in housing/sliding flange.

Screw start-of-delivery blocking device 0 986 611 746 (KDEP 1077) into bore and precisely fix position of pulse wheel (arrow).

Continue: E05/1 Fig.: E04/2

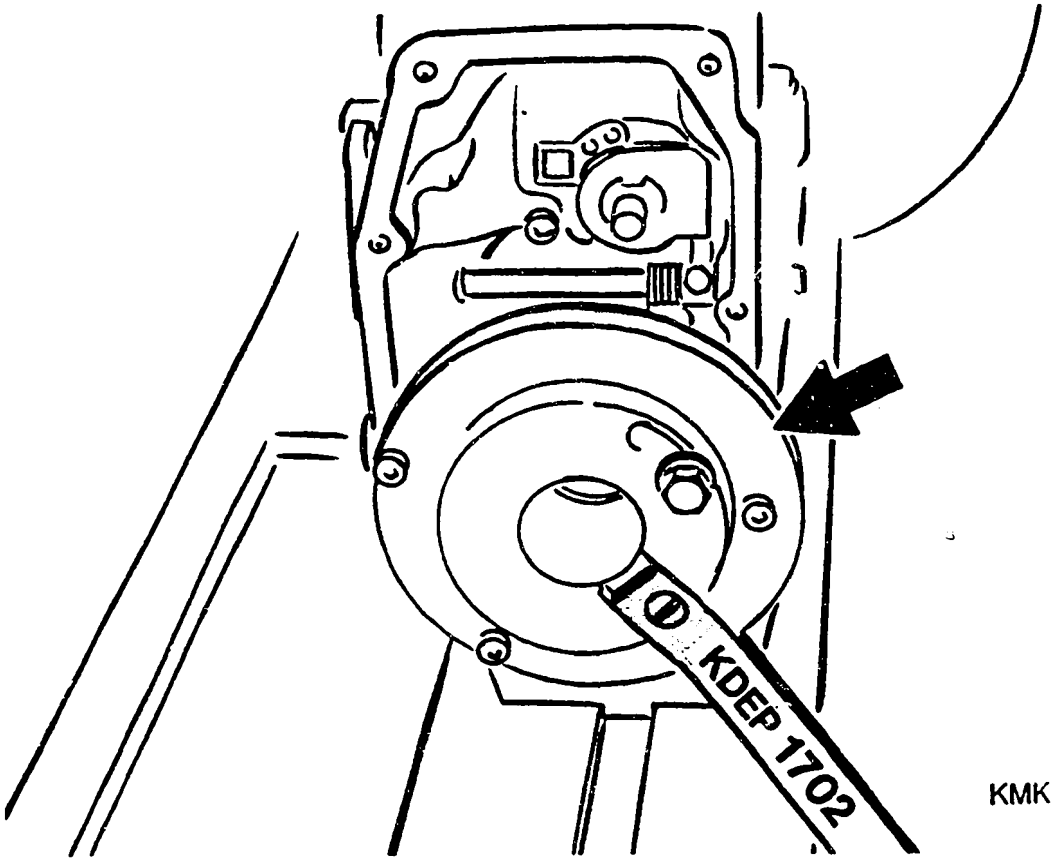


KMK 01045

POSITIONER ASSEMBLY

Securing pulse wheel against turning:
Screw on backing plate of holding device 0 986 612 305 (KDEP 1702) (arrow) at 4 tapped holes on bottom of positioner housing; do not as yet tighten the 4 screws.
Note: Rework backing plate for positioner with sliding flange, see coordinate: A20/1
Insert adjusting ring of holding device such that lugs engage in pulse wheel.
Screw adjusting ring to backing plate in slot and tighten the 4 screws.

Continue: E06/1 Fig.: E05/2



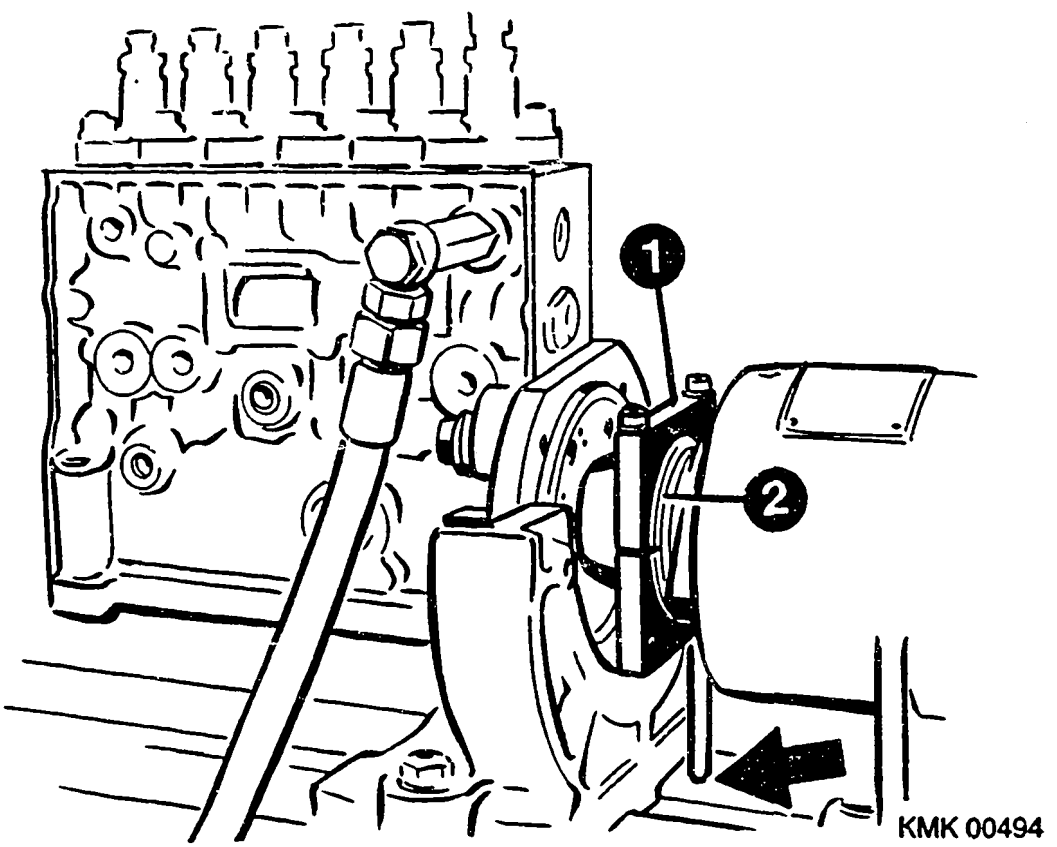
KMK 01046

POSITIONER ASSEMBLY

Blocking camshaft with camshaft blocking device 0 986 612 056 (KDEP 1545):
Position blocking device (1) on shim (2) - already attached to coupling - such that support pin faces in direction of rotation of pump and is supported by test-bench bed (arrow).
Tighten tensioning screws.

Note:
Refer to following coordinate.

Continue: E07/1 Fig.: E06/2



POSITIONER ASSEMBLY

Note: on operation described above:

Pump versions, where the injected-quantity tests have to be performed with the genuine engine multi-plate clutch, are likewise to be equipped for this operation with the 2-claw drive coupling.

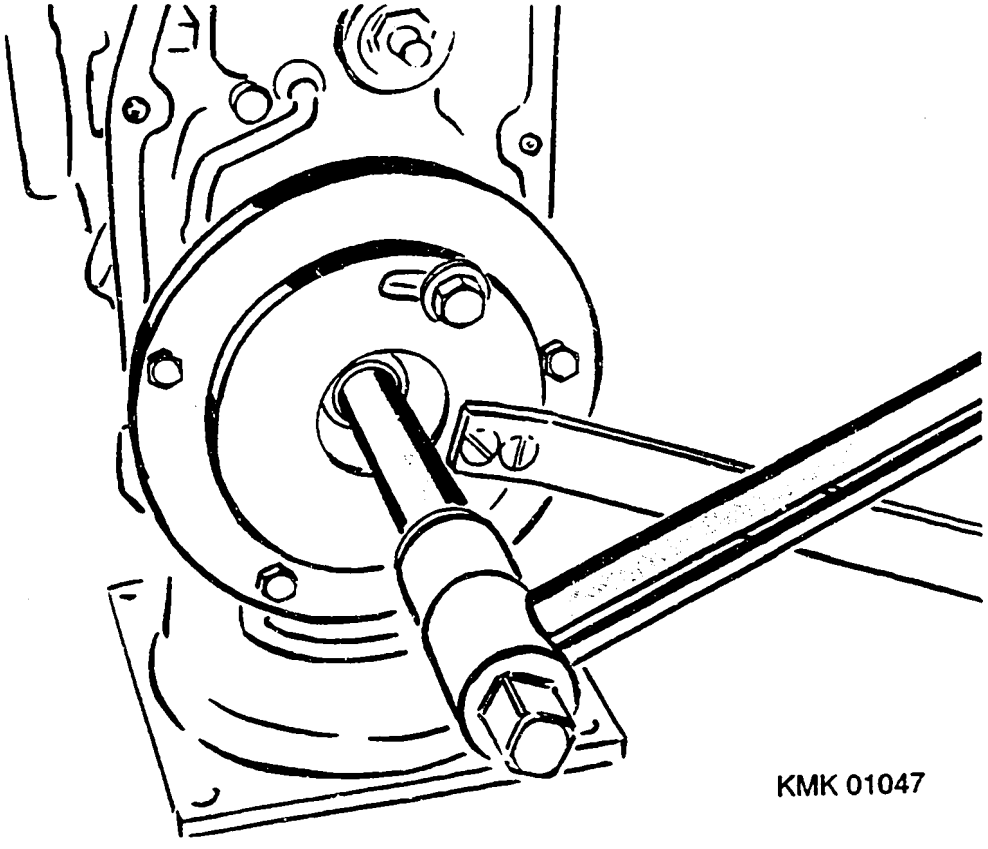
Refer to Technical Bulletin "drive couplings, holding pieces, etc." (See W-400/00.).

Continue: E08/1

POSITIONER ASSEMBLY

After blocking pulse wheel and camshaft, remove start-of-delivery blocking device 0 986 611 746 and tighten pulse-wheel fastening nut on camshaft to tightening torque of 80...90 Nm (taper 17 mm) or 90...100 Nm (taper 20 mm).
Check position of pulse wheel again.
In the case of positioner with sliding flange, precise correction can be effected by moving the flange in the slot. Finally tighten screws of sliding flange; head of break-off screw(s) must come off.

Continue: E09/1 Fig.: E08/2

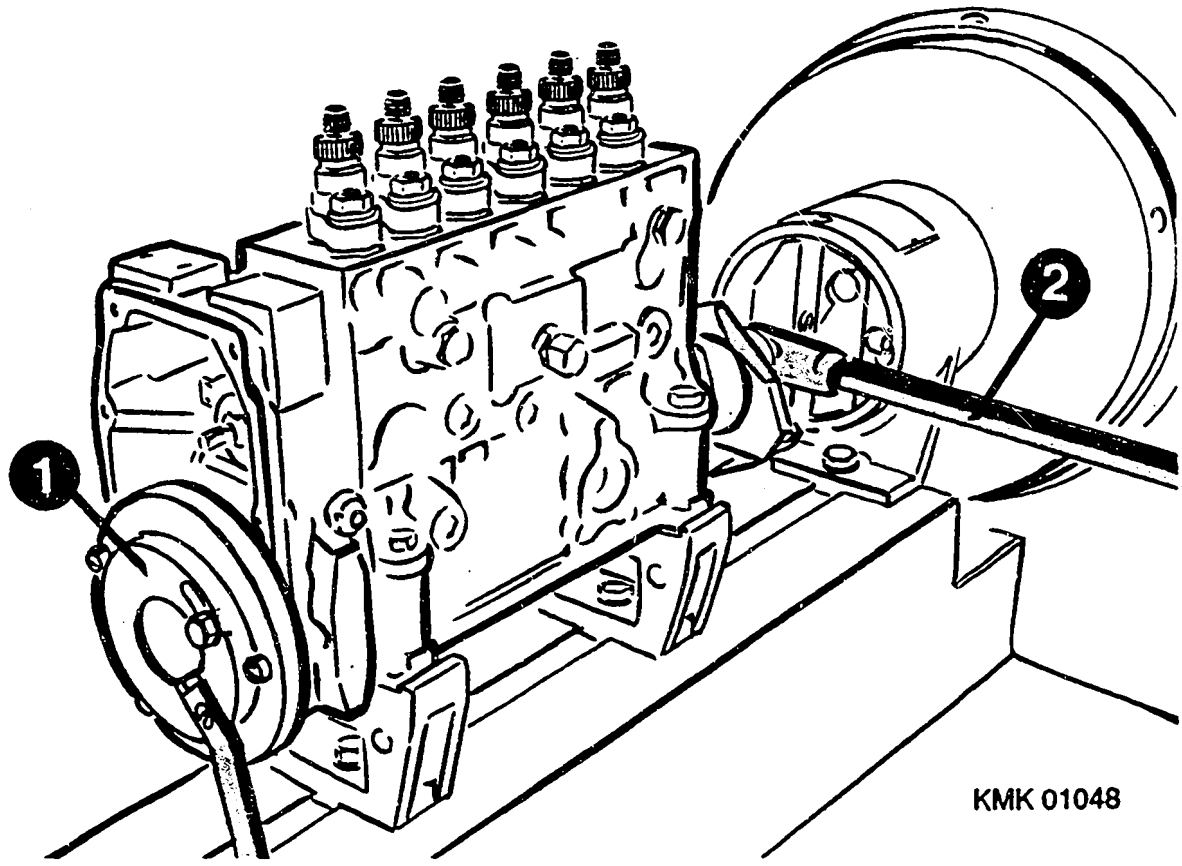


KMK 01047

POSITIONER ASSEMBLY

Checking tightness of pulse wheel on camshaft taper (applies to all positioners with 17 mm pulse wheel taper):
Holding device 0 986 612 305 (KDEP 1702) (1) for pulse wheel remains in position. Disassemble camshaft blocking device 0 986 612 056 (KDEP 1545).
Use torque wrench (2) on pump drive end to check whether pulse wheel remains securely in position on camshaft taper given a turning torque of max. 150 Nm. If this is not the case, the entire pulse-wheel assembly procedure must be repeated.

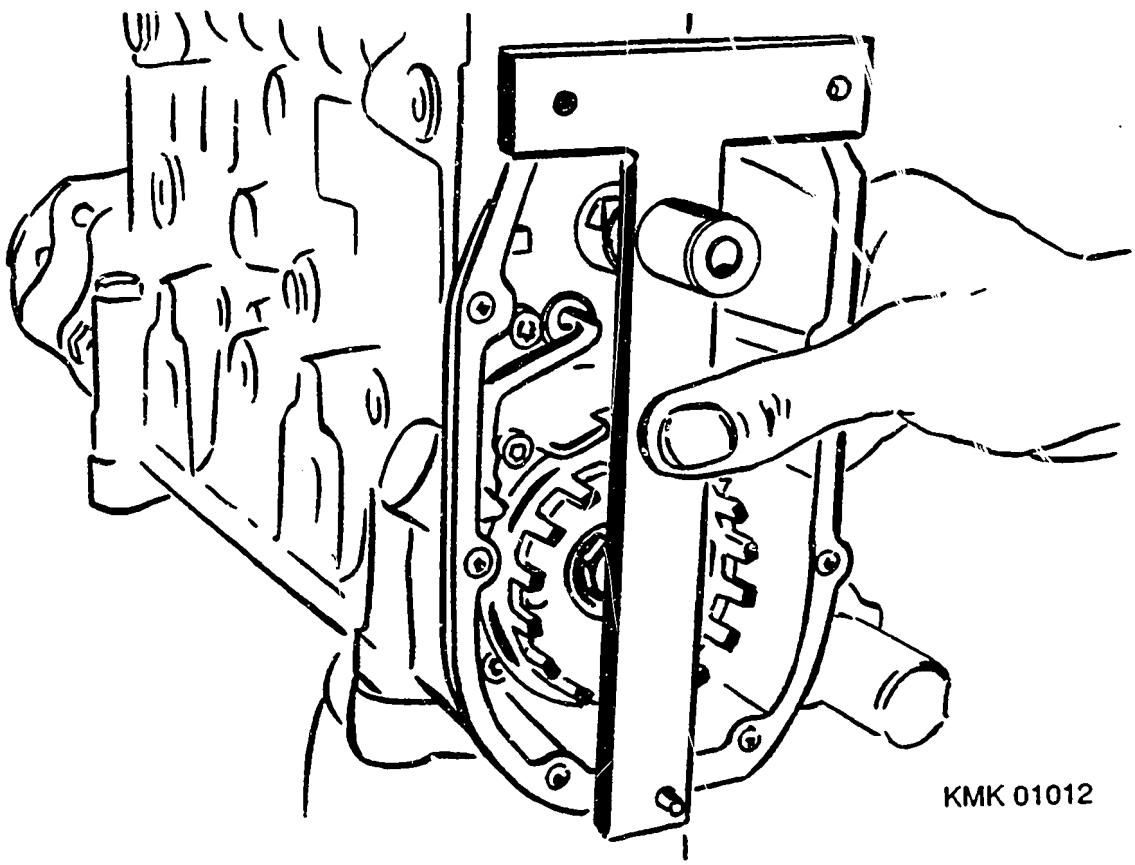
Continue: E10/1 Fig.: E09/2



POSITIONER ASSEMBLY

Take following measurements before fitting positioner cover:
Check position of RPS shorting ring at control rod using setting gauge 0 986 612 308 (KDEP 1703):
Position setting gauge with retracted measuring pin at housing (positioning hole at bottom, tapped hole top left). It must then be possible to insert the first stage (smallest diameter) of the measuring pin into the shorting ring and make contact with it in the bottom left corner. Refer to picture on next coordinate.

Continue: E11/1 Fig.: E10/2



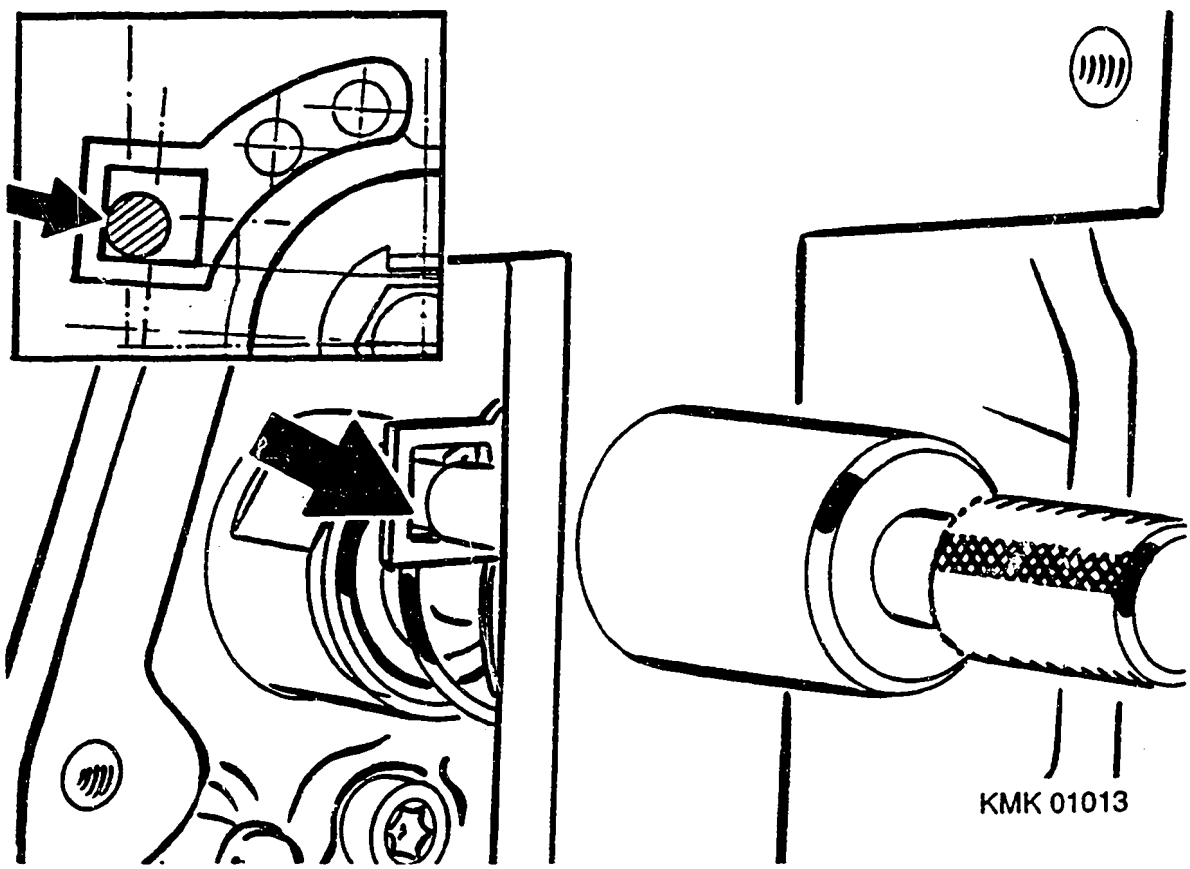
POSITIONER ASSEMBLY

Position of measuring pin in shorting ring (smallest diameter, arrow).

If the position of the shorting ring does not correspond to the setting gauge, replace control rod (complete unit). In other words, disassemble fuel-injection pump.

Note: To remove unit, screw control rod out of pump-housing bushing on positioner side and pull it out. After replacing control rod and assembling fuel-injection pump, check position of shorting ring again.

Continue: E12/1 Fig.: E11/2



POSITIONER ASSEMBLY

Calibration of thrust pin in servo-magnet armature - "X":

Dimension "X" = clearance between thrust pin and control rod with positioner cover fitted.
Set value: 0.1...0.3 mm.
Note: New positioner covers/new servo magnets are supplied without thrust pin.
The measurement method described in the following applies both to testing and possible correction with a thrust pin and to re-calibration with a new positioner cover or new servo magnet.

Continue: E13/1

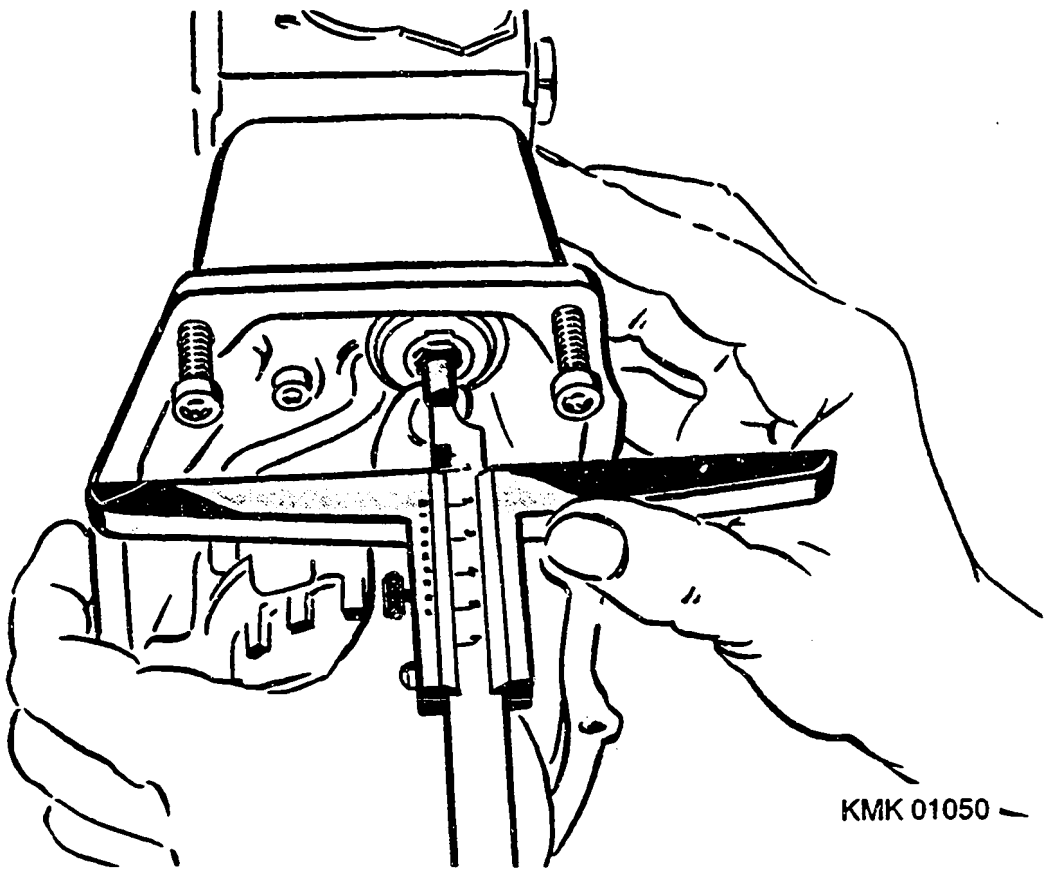
POSITIONER ASSEMBLY

* Dimension "a": Use a small quantity of grease to stick new seal for positioner cover to positioner housing.

Press control rod onto stop (start position) and use depth gauge to measure distance between parting surface (with seal) and cap nut - control rod.

Note down dimension "a".

Continue: E14/1 Fig.: E13/2

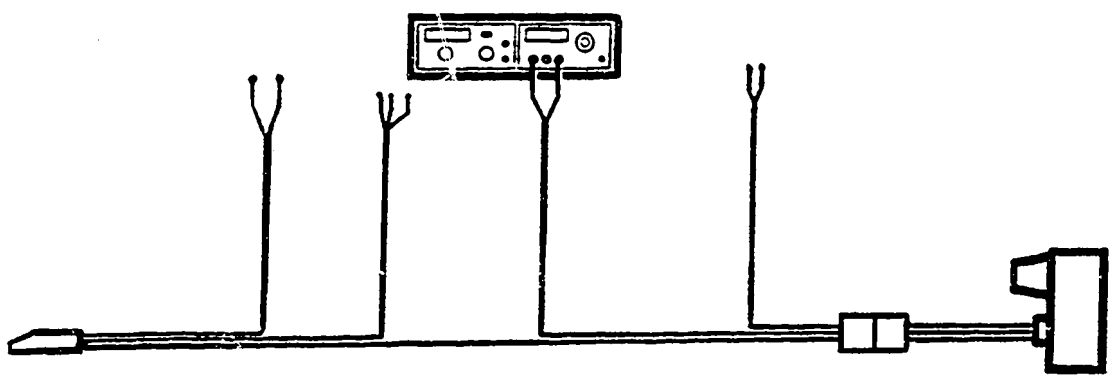


POSITIONER ASSEMBLY

* Dimension "b": Connect up universal test lead 0 986 610 102 (KDEP-P 400/2) with adapter lead in line with positioner version (see tester list) to positioner cover and place cover on suitable (wooden) support.

  Connect up magnet actuation lead for pin terminal of test-lead set - red plug positive, black plug negative - to variable regulator 12 V / 15 A.

Continue: E15/1 Fig.: E14/2



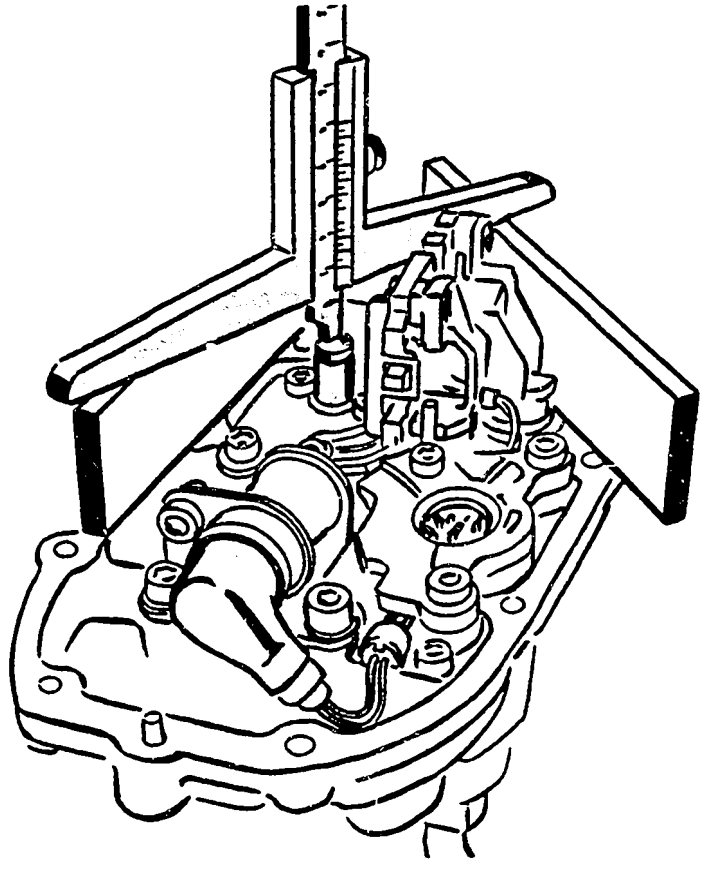
KMK 01051

POSITIONER ASSEMBLY

Place two straight edges of equal width (width approx. 25 mm) on parting surface of positioner cover (without seal). Switch on regulator. Set current such that armature extends as far as it will go.
Use depth gauge to measure distance from straight edge to thrust pin of armature, or to end face of armature in the case of a new magnet (with no thrust pin)(picture).

Important note:
Restrict measurement procedure to max. 1 minute on account of heating-up of magnet.

Continue: E16/1 Fig.: E15/2



KMK 01052

POSITIONER ASSEMBLY

Calculation of dimension "b": Width of straight edge minus measured dimension.

Example:

Width of straight edge	= 25.0 mm
Minus measured dimension	= 4.1 mm
Dimension "b"	= 20.9 mm

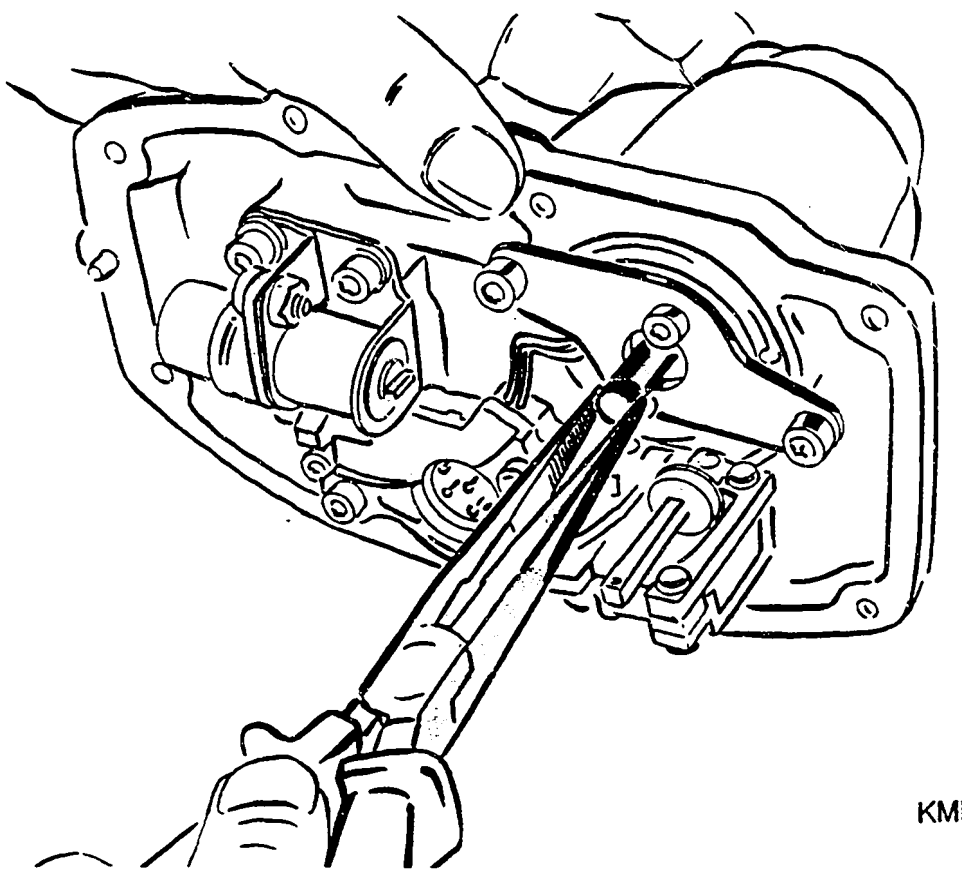
Continue: E17/1

POSITIONER ASSEMBLY

* Calculation of dimension "X":
  Dimension a minus
  dimension b = dimension X.
  Example: Dimension a = 21.4 mm
  Dimension b = 20.9 mm

  Dimension X = 0.5 mm
  Set value for
  dimension X: 0.1...0.3 mm
  Result: Dimension X is too large
  by 0.2...0.4 mm
  Correction: Use pliers to remove thrust pin of armature (held by a retainer). Press in 0.2 mm longer thrust pin (dimension groups in 0.2 mm graduation as per service-parts list) as far as it will go (results in dimension X = 0.3 mm).

Continue: E18/1 Fig.: E17/2

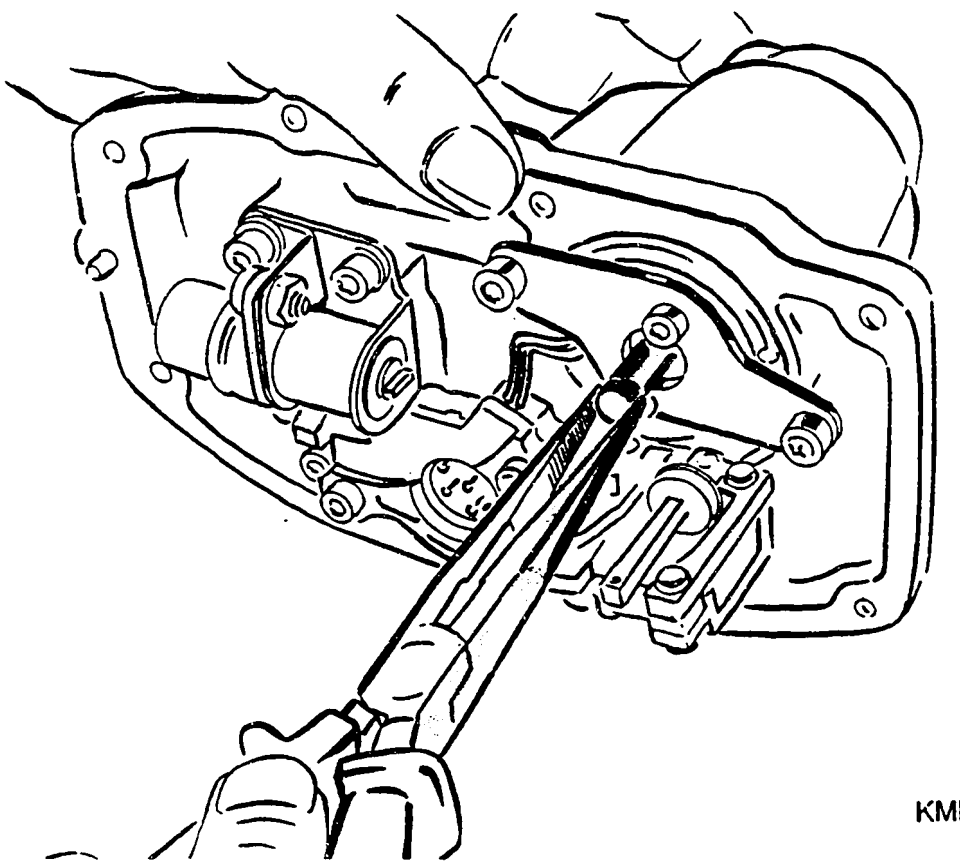


KMK 01053

POSITIONER ASSEMBLY

Setting for new positioner cover:
Select new thrust pin 0.1...0.3 mm smaller than determined dimension X and press into armature as far as it will go with retainer.

Continue: E19/1 Fig.: E18/2



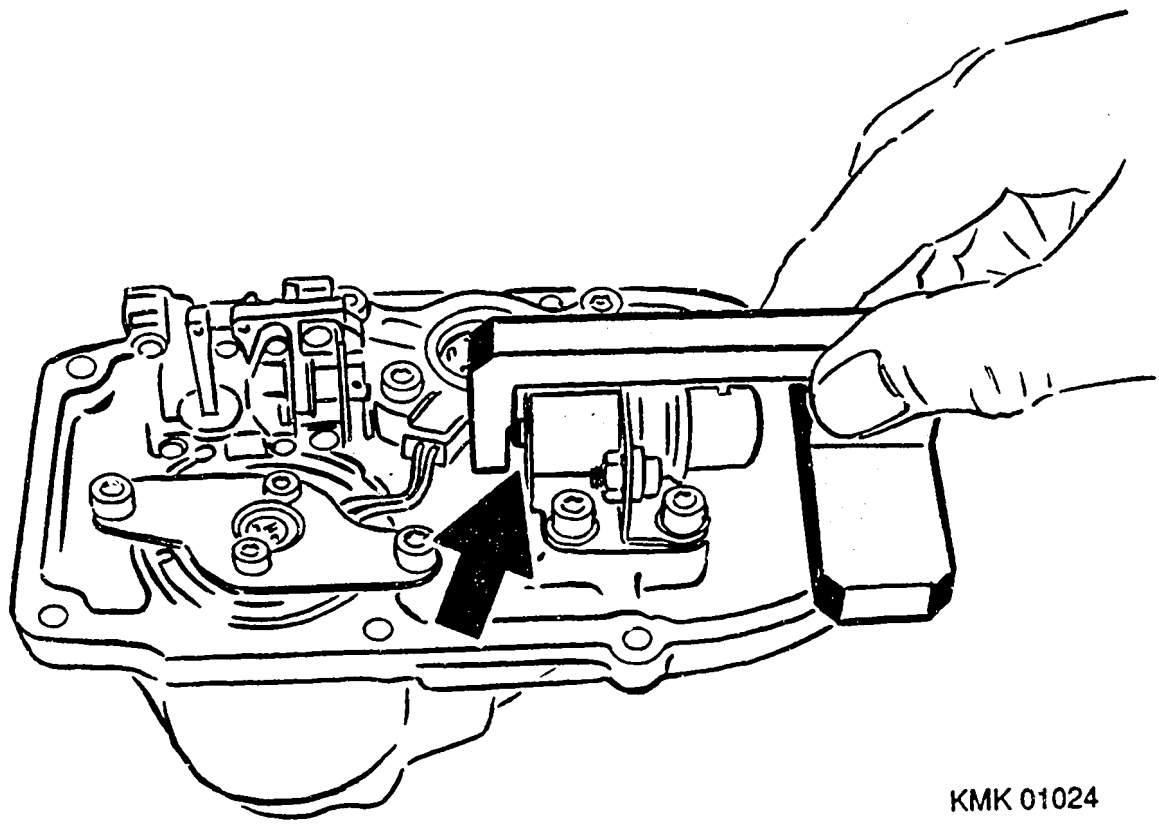
KMK 01053

POSITIONER ASSEMBLY

Checking position of speed pulse generator in positioner cover:

Attach adjustment gauge 0 986 612 301 (KDEP 1701) to positioning pin of positioner cover. Check whether terminal of pulse generator makes contact with measurement surface of gauge without pressure being exerted (arrow).
If necessary, screw adjustment gauge to positioner cover. Loosen the three fastening screws and shift pulse generator until it makes contact with measurement surface of gauge.
Tighten fastening screws to tightening torque of 9...11 Nm.

Continue: E20/1 Fig.: E19/2



KMK 01024

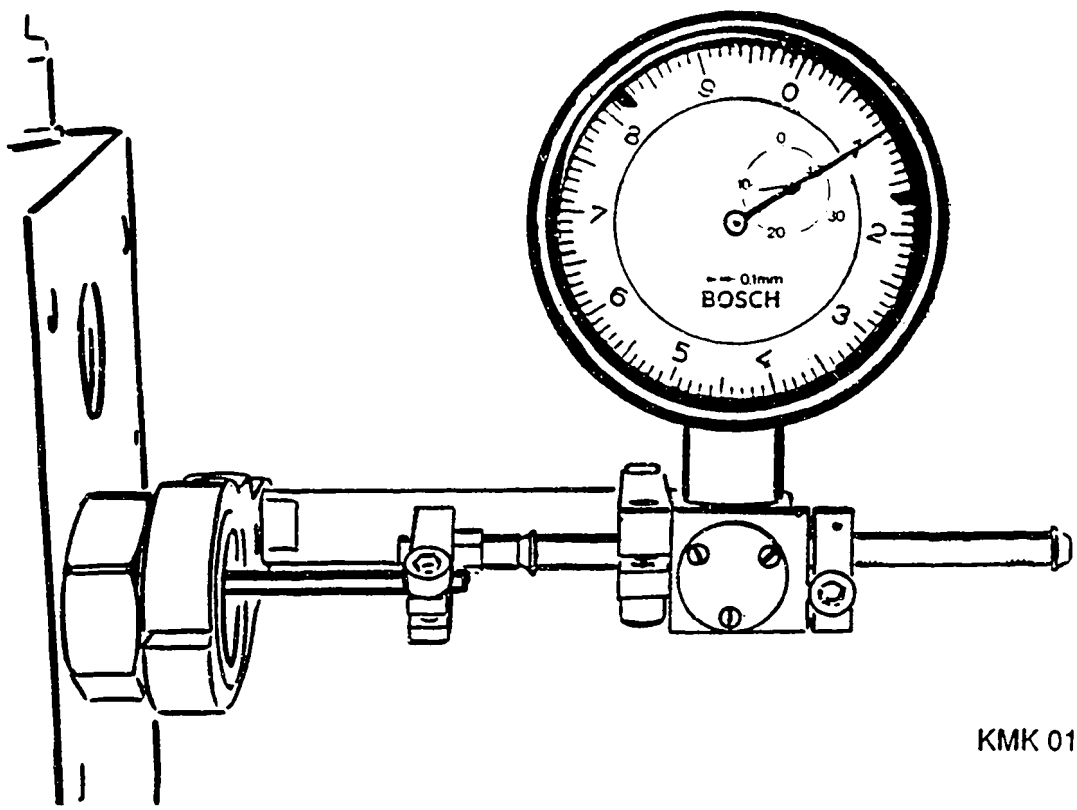
POSITIONER ASSEMBLY

Attach control-rod-travel measuring device 1 688 130 130 with accessory set 1 687 000 053 and threaded sleeve 1 683 315 022 (special accessory for control-rod-travel measuring device) to pump.

Press control rod by hand into start position (as far as stop) and set control-rod-travel dial indicator to precisely 21 mm control-rod travel.

Ensure that dial indicator is not adjusted during subsequent assembly of the positioner cover.

Continue: E21/1 Fig.: E20/2



KMK 01055

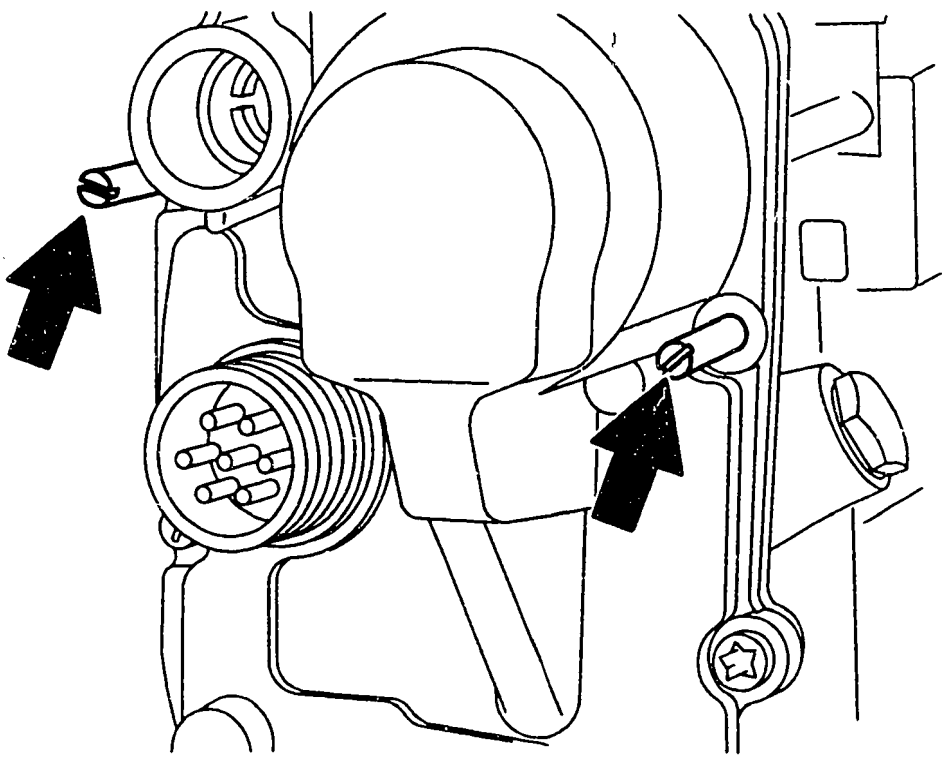
POSITIONER ASSEMBLY

Fitting complete cover with new seal on positioner housing:

Screw the two guide pins 0 986 612 598 as assembly aid into the cover fastening holes roughly on a level with the magnet. Place cover in position with pins providing guidance. In doing so, insert measurement arm of rack position sensor into shorting ring of control rod such that there is no contact. Take care not to damage speed pulse generator with pulse wheel. Press on cover; screw screws with lock washers into free holes.

Continue: E22/1 Fig.: E21/2

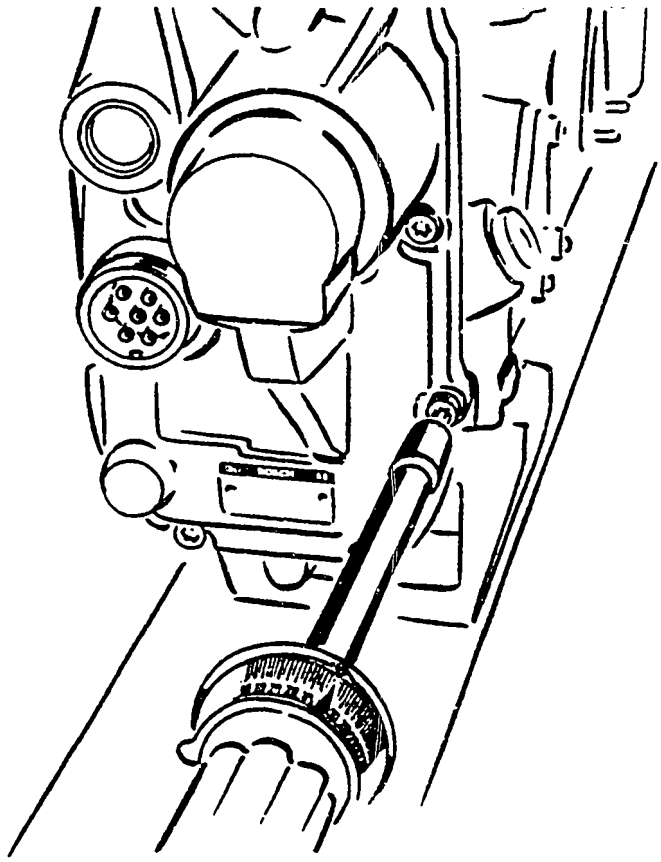
KMK04486



POSITIONER ASSEMBLY

Screw out guide pin 0 986 612 598.
Screw in remaining cover fastening screws and tighten to tightening torque of 7...9 Nm.

Continue: E23/1 Fig.: E22/2



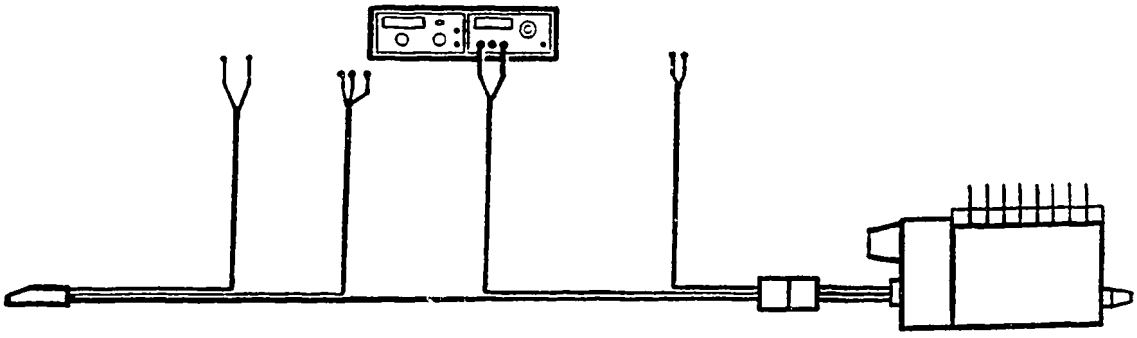
KMK 01056

POSITIONER ASSEMBLY

Connect up universal test lead 0 986 610 102 (KDEP-P 400/2) with adapter lead in line with positioner version (see tester list) to positioner.
Connect up magnet actuation lead for pin terminal (red plug positive, black plug negative) to regulator 12 V/15 A (variable).

Switch on regulator. Set current such that control rod attains maximum travel. CRT must then be 20.7...20.9 mm. This procedure must not take more than 1 minute.

Continue: E24/1 Fig.: E23/2



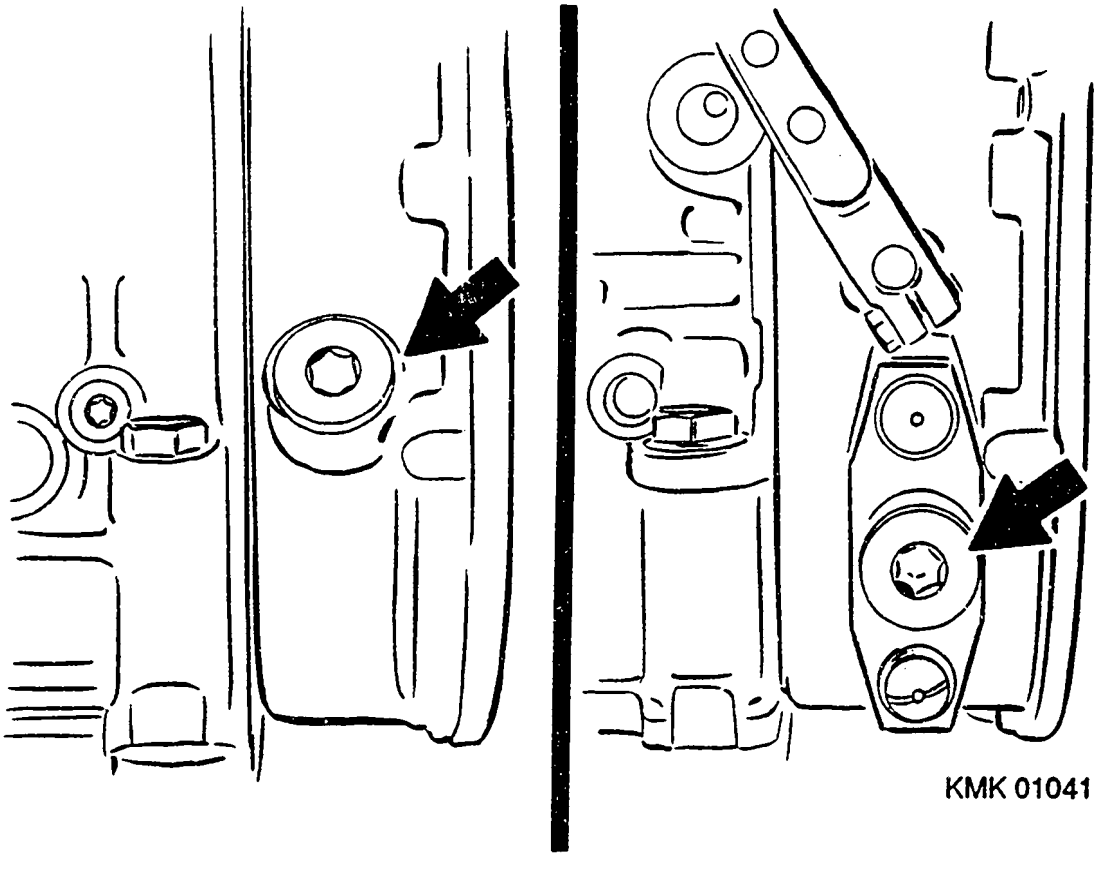
KMK 01057

POSITIONER ASSEMBLY

If this value is not correct, dimension "X" has been calibrated incorrectly (thrust pin in servo-magnet armature) and the procedure is therefore to be repeated.

Pour approx. 100 cm3 of oil SAE 20W 20 into positioner by way of lateral start-of-delivery hole in housing or adjusting flange (arrows). This must be done prior to commissioning, as otherwise the heat of friction will destroy the oil pump.

Continue: N27/2 Fig.: E24/2



KMK 01041

TEST AND ADJUSTMENT INSTRUCTIONS

The following instructions give a detailed description of all operations required for testing and adjustment of P-type injection pumps with RE positioner.

So as not to make these instructions unnecessarily long, there is no detailed description of operations which do not differ from those to be carried out on mechanically governed units, but rather mention is merely made of such operations at the appropriate points with supplementary notes being given in some cases.

This essentially applies to the following Sections:

Continue: F01/2

TEST AND ADJUSTMENT INSTRUCTIONS

Sections not described in detail:

* Mounting of fuel-injection pump on and connection to test bench.
* Selection of appropriate holding pieces and drive couplings.
* Operation of test bench.
* Testing and adjustment of prestroke, start of deliver, angular cam spacing and start-of-deliver mark.
* Start-of-delivery adjustment and equalization.

Reference is made in this respect to the corresponding, familiar documentation.

Continue: F02/1

TEST AND ADJUSTMENT INSTRUCTIONS

Additional instructions:

The basic prerequisite for the injected-quantity setting of the fuel-injection pump is precise adjustment of the rack position sensor in the positioner.

The sequence of operations in these test instructions is established in line with this stipulation.
It is always to be complied with if any work has been performed, e.g. repair work, on the positioner or fuel-injection pump.

Continue: F02/2

TEST AND ADJUSTMENT INSTRUCTIONS

Additional instructions:

On the other hand, the specified sequence is not to be complied with if an injection-pump assembly is only delivered for checking, e.g. warranty testing.

In such cases, the following sequence is to be employed:

Continue: F03/1

TEST AND ADJUSTMENT INSTRUCTIONS

1. Injected-quantity testing as described in these instructions, however no correction if values outside tolerance. The cause may be both incorrect injected-quantity adjustment and incorrect rack-position-sensor adjustment. Injected-quantity correction without knowledge of the rack-position-sensor setting could serve to worsen the fault.

Continue: F03/2

TEST AND ADJUSTMENT INSTRUCTIONS

2. Testing and, where appropriate, adjustment of rack position sensors. The injected quantity can only be corrected when the rack position sensor has been correctly set.

3. Injected-quantity adjustment at barrel-and-valve assemblies of fuel-injection pump.

Continue: F04/1

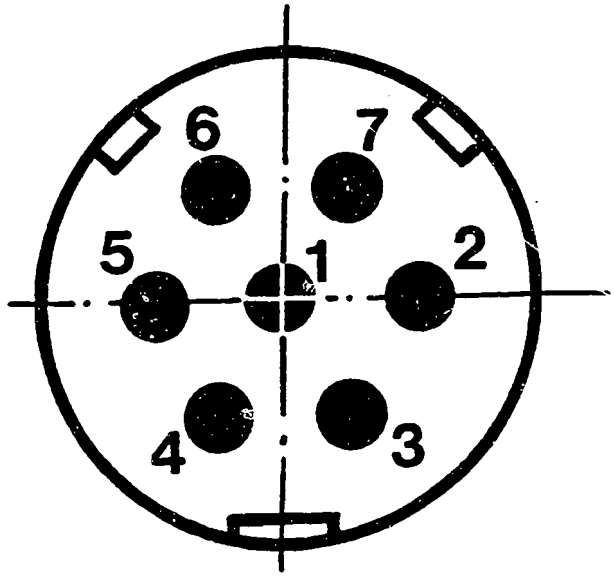
Incoming inspection:

Positioner with housing-fixed round plug connection:

Resistance measurements between contact pins:

1-6 (RPS-coil 1)	17...23 Ohm
6-5 (RPS-coil 2)	17...23 Ohm
1-5 (RPS total)	34...46 Ohm
2-7 (Servo-magnet)	0,55...0,90 Ohm
3-4 (Speed sensor)	900...1200 Ohm

Continue: F05/1 Fig.: F04/2



KMK 01023

TESTING AND ADJUSTMENT INSTRUCTIONS

Incoming inspection:

Positioner with cable bushing and overhung Schlemmer plug:

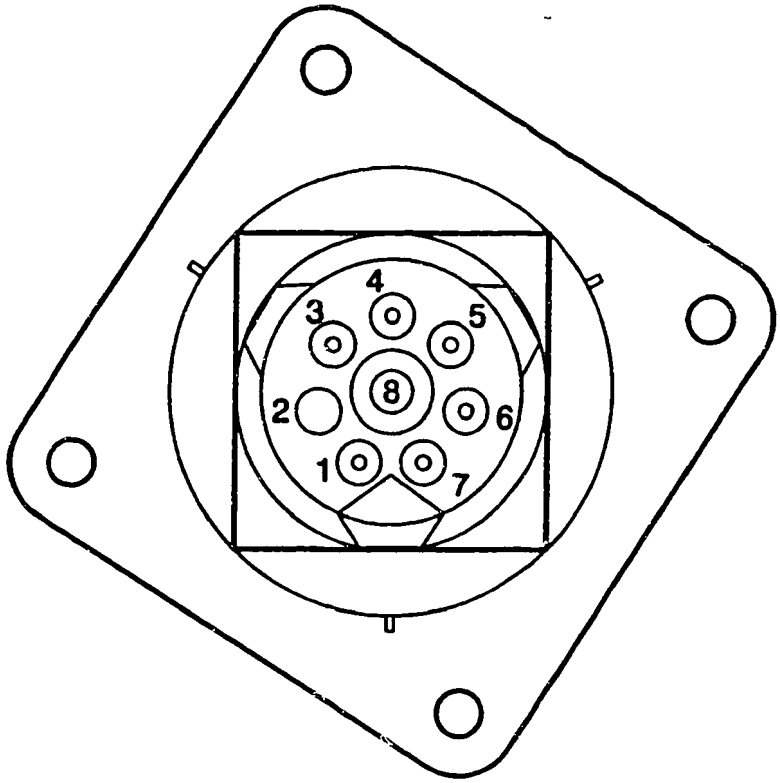
Resistance measurements at 8-pin plug between contact pins:

1–6 (RPS–coil 1)	17...23 Ohm
5–6 (RPS–coil 2)	17...23 Ohm
1–5 (RPS total)	34...46 Ohm
7–8 (Servo–magnet)	0.55...0.90 Ohm
3–4 (Speed sensor)	900...1200 Ohm

Contact 2 is not used.

Continue: F06/1 Fig.: F05/2

KMK04487



TESTING AND ADJUSTMENT INSTRUCTIONS

Incoming inspection:

Positioner with cable bushing and overhung Deutsch plug:

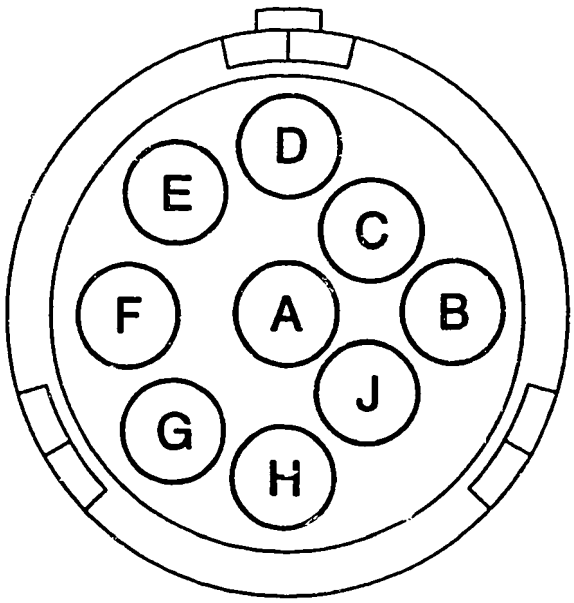
Resistance measurements at 9-pin plug between contact pins:

A–F (RPS–coil 1)	17...23 Ohm
E–F (RPS–coil 2)	17...23 Ohm
A–E (RPS total)	34...46 Ohm
B–G (Servo–magnet)	0.55...0.90 Ohm
C–D (Speed sensor)	900...1200 Ohm

Contacts H and J are not used.

Continue: F07/1 Fig.: F06/2

KMK04488



TESTING AND ADJUSTMENT INSTRUCTIONS

Incoming inspection:

If the above-mentioned resistance measurements produce readings which are not within the tolerance band, the positioner cover is to be repaired (replacement of component concerned).

Continue: F08/1

TEST AND ADJUSTMENT INSTRUCTIONS

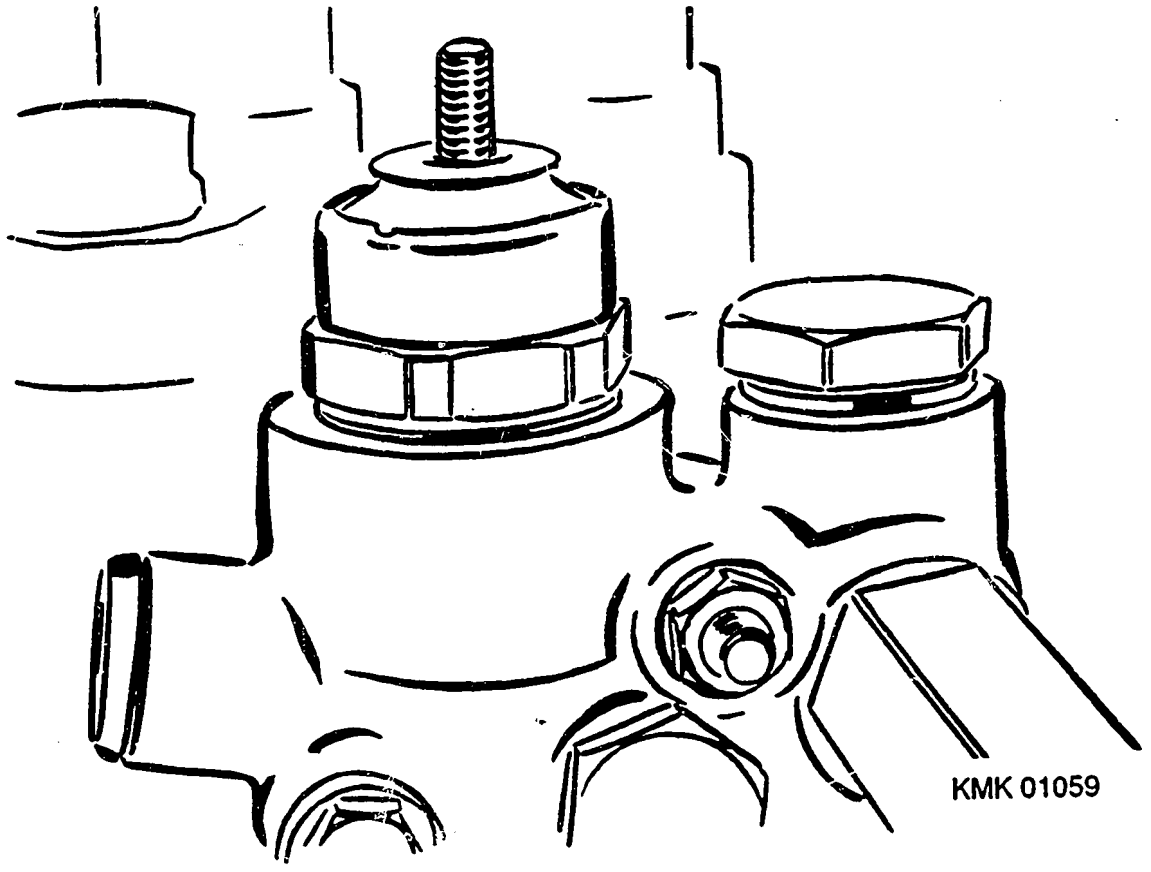
Preliminary testing of ELAB
(if provided):

* Resistance measurement between ELAB connection and housing.
  Set value:
  12 V version: 9.8...11.4 ohms
  24 V version: 42...48 ohms

* Briefly apply 12 V to ELAB:
  ELAB must be heard to click (likewise applies to 24 V version).

Replace defective ELAB.
Tightening torque: 50...60 Nm.
Note: ELAB functional test is performed within the framework of injected-quantity measurements.

Continue: F09/1 Fig.: F08/2



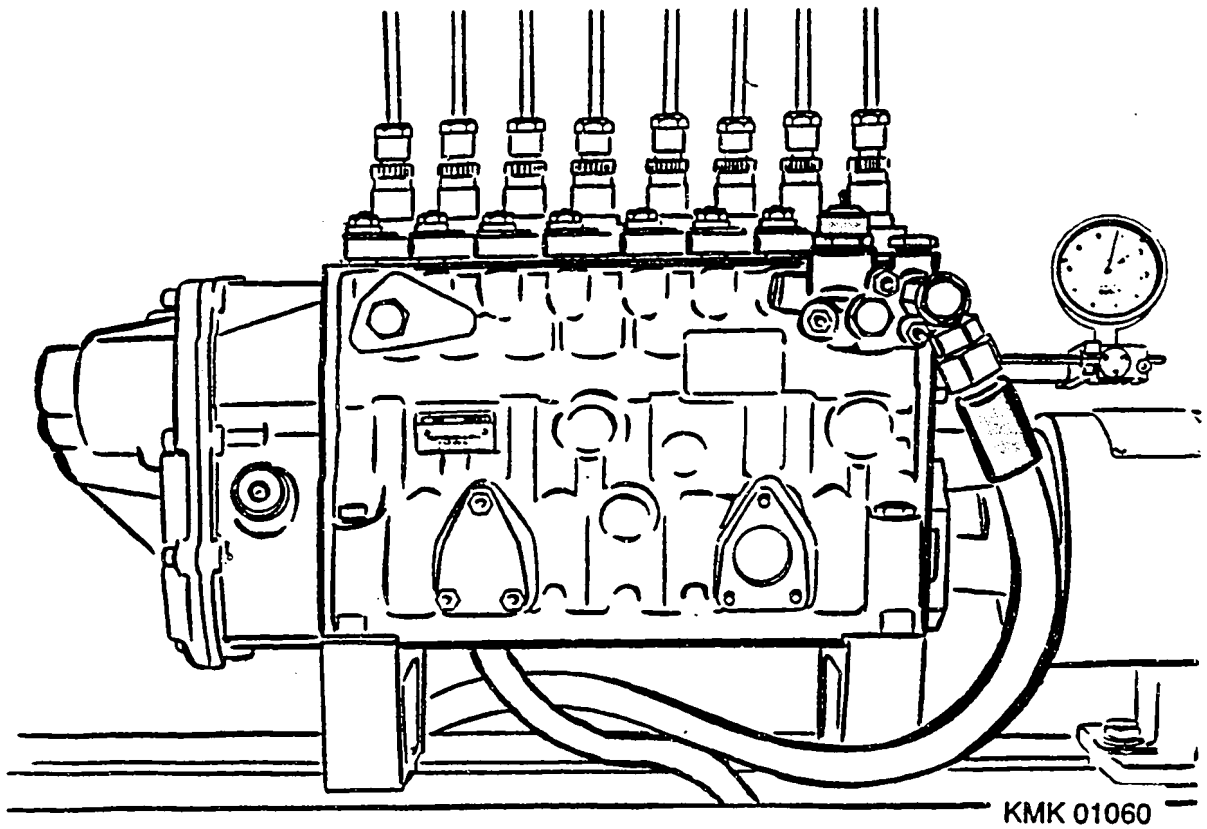
TEST AND ADJUSTMENT INSTRUCTIONS

Mount fuel-injection pump with positioner on injection-pump test bench.

Attach control-rod-travel measuring device 1 688 130 130 with accessory set 1 687 000 053 and threaded sleeve 1 683 315 022.

Determine and connect up test equipment as per test-specification sheet.

Continue: F10/1 Fig.: F09/2

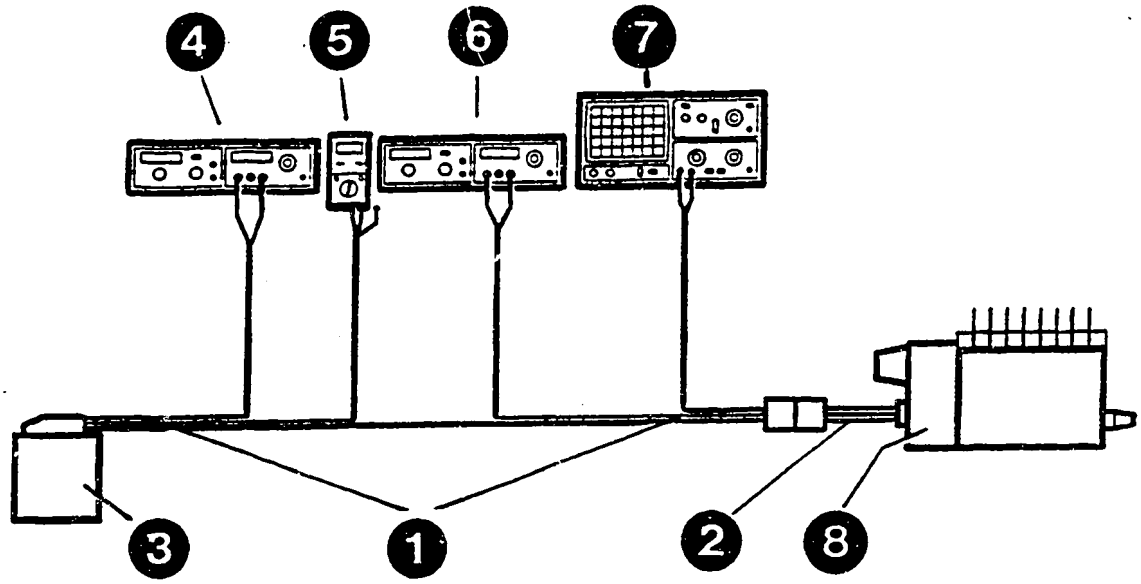


TESTING AND ADJUSTMENT INSTRUCTIONS

Connect up test and supply components with set of leads as per connection diagram and labelled legend:

1 = Universal test lead 0 986 610 102 (KDEP-P 400/2).
2 = Adapter lead for positioner connection in line with positioner version.
3 = Test control unit (universal evaluation circuit) 0 986 610 101 (KDEP-P 400/1).
4 = Regulator 12 V/3 A
Connector: red (+), black (-).

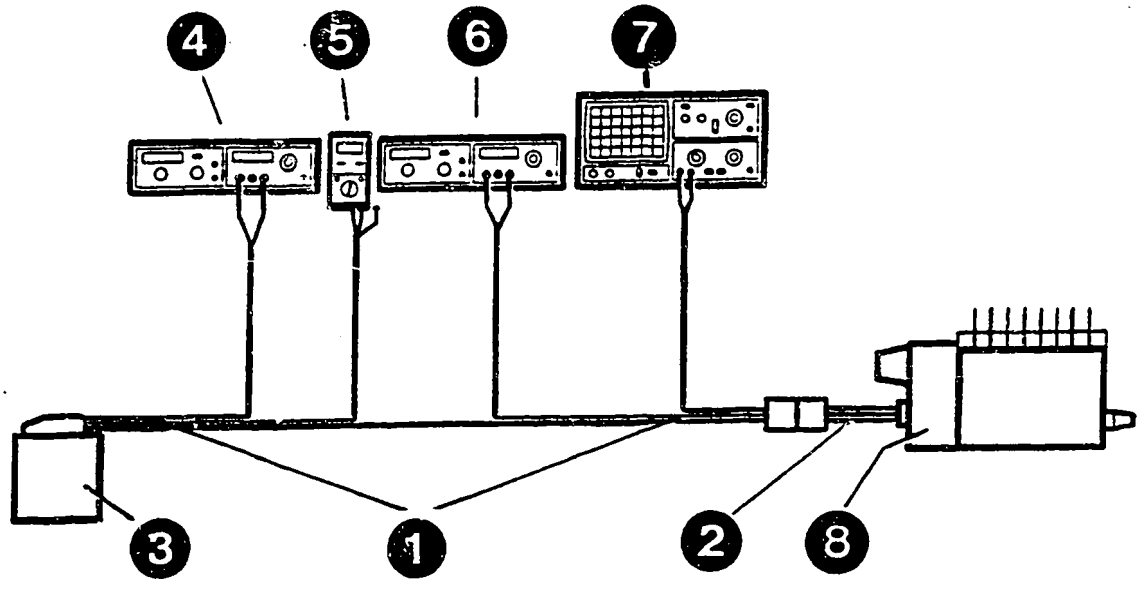
Continue: F11/1 Fig.: F10/2



KMK 01061

5 = Digital voltmeter 0...5 V.
Connector: red = reference voltage (U/ref), green = output voltage (U/act), blue = measurement ground.
6 = Regulator 12 V/15 A (variable)
Connector: red (+), black (−).
7 = Oscilloscope
Connector: blue, green
Connection only for testing speed sensor.
8 = Positioner
Connection: adapter lead in line with positioner version.

Continue: F12/1 Fig.: F11/2



KMK 01061

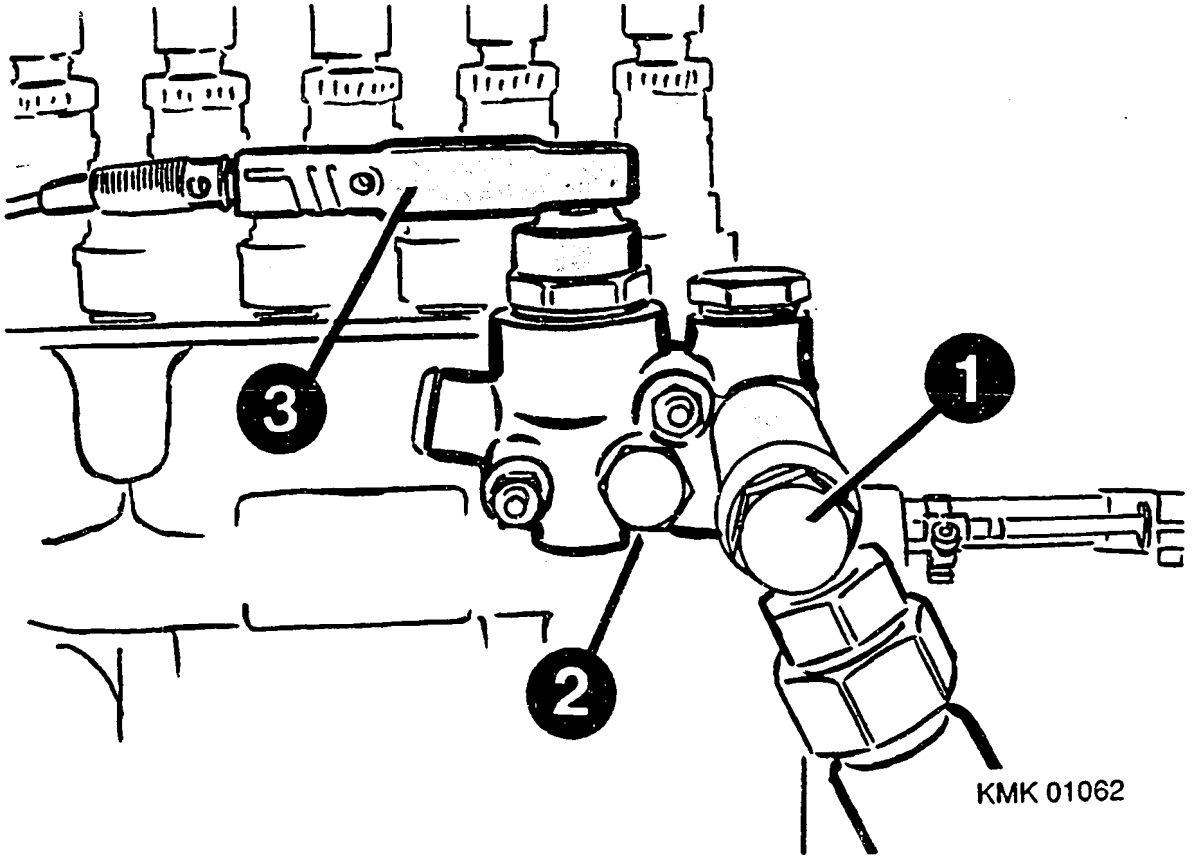
TEST AND ADJUSTMENT INSTRUCTIONS

Start-of-delivery testing and adjustment:

Procedure as for mechanically governed fuel-injection pumps.

Additional information for pump versions with ELAB:
Calibrating-oil inlet at ELAB housing, connection M 14 x 1.5 (1). Seal off connection for pressure relief at ELAB housing (2).
Picture shows example. Connections differ depending on ELAB housing.
Seal off connection for calibrating-oil return at pump suction gallery.
3 = Electrical connection.

Continue: F13/1 Fig.: F12/2

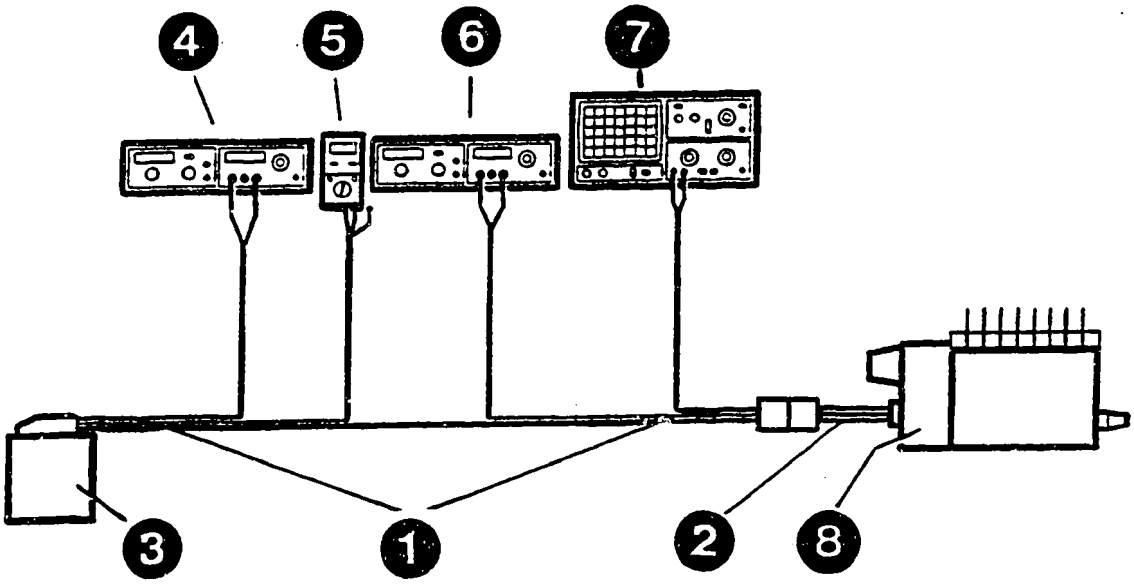


Start-of-delivery testing and adjustment:

Connect up volt. supply for ELAB (12V, e.g. from regul. for test control unit) prior to calib.-oil pressure build-up.

Adjustment of control-rod-travel measuring device:
Switch on regulator (6) for positioner. Slowly increase current starting from OA until control rod attains maximum. control-rod travel (start position). Set control-rod-travel measuring device to exactly 21 mm control-rod travel. Maximum time for procedure 1 minute on account of heating-up of servo magnet. Do not use excessive current - max. 11 A.

Continue: F14/1 Fig.: F13/2



KMK 01061

TEST AND ADJUSTMENT INSTRUCTIONS

Start-of-delivery testing and adjustment:

Adjustment of control-rod travel for start of delivery as per test-specification sheet:

Set control-rod travel by setting current on regulator (precision adjustment by hand) and block with control-rod-travel measuring device.
Do not switch off regulator.
Following completion of test work, release blocking mechanism and set current to 0 A (control-rod shutoff position).

Continue: F15/1

TESTING AND ADJUSTMENT INSTRUCTIONS

Preparation for checking positioner and injected quantity:

Electrical test equipment:

Switch on regulator for supplying test control unit (evaluation circuit).
Setting: 13.0...14.0 V, approx. 2 A.

Continue: F15/2

TESTING AND ADJUSTMENT INSTRUCTIONS

Preparation for checking positioner and injected quantity:
Voltmeter:
* Connection for testing U/ref (reference voltage of test control unit/ supply voltage for RPS): red (+), blue (−).
  Desired reading: 4.99...5.01 V.
  Incorrect value: tester defective.
* Connection for all other tests (U/act): green (+), blue (−).

Note: U/act represents the voltage calculated by the tester from the RPS signal and is thus a measure of the control rod travel.

Continue: F16/1

TEST AND ADJUSTMENT INSTRUCTIONS

Preparatory work prior to positioner and injected-quantity testing:

Switch on regulator for positioner.
Current setting: Initially 0 A.

Note: The control rod can be moved as desired by way of the current setting on the regulator; this is not possible by hand on account of the strong return spring of the control rod. The continuous application of current for maximum control rod travel is to be limited to a maximum of 1 minute on account of the heating-up of the servo magnet.

Continue: F16/2

TEST AND ADJUSTMENT INSTRUCTIONS

Preparatory work prior to positioner and injected-quantity testing:

Connect up 12 V power supply to ELAB (if provided) (where appropriate from regulator for test control unit).
Positive to ELAB connection, ground to pump housing, current consumption < 2 A. ELAB must remain connected during the course of all further testing.
Oscilloscope: This is only connected up for testing the speed signal.

Continue: F17/1

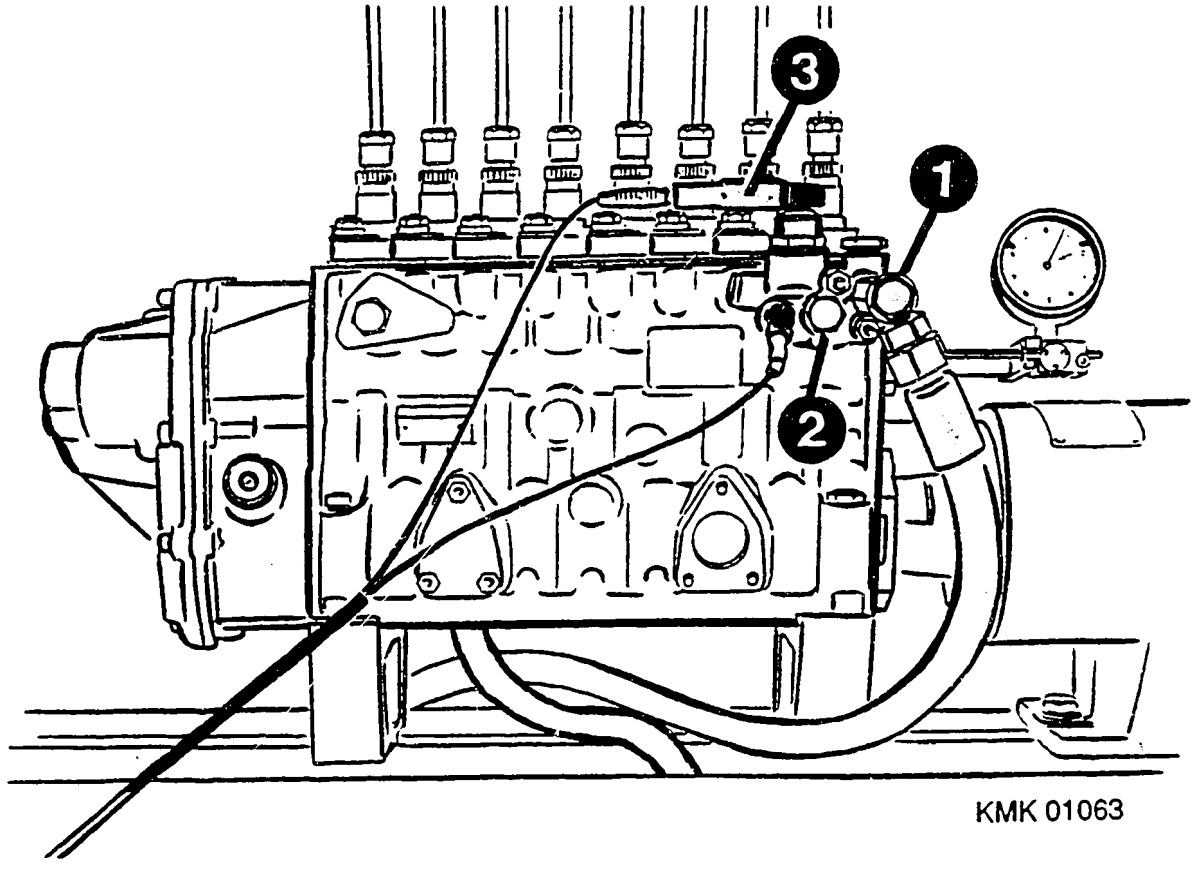
TEST AND ADJUSTMENT INSTRUCTIONS

Additional information for pump versions with ELAB:

Calibrating-oil inlet at ELAB housing, connection M 14 x 1.5 (1). Seal off connection for pressure relief at ELAB housing (2). Picture shows example. Connections differ depending on ELAB housing.

Connect up prescribed overflow valve (as per test-specification sheet) and calibrating-oil return to pump suction gallery.
Note: Return connection as in vehicle or – in the event of uncertainty – to the suction-gallery connection furthest away from the ELAB.

Continue: F18/1 Fig.: F17/2



TEST AND ADJUSTMENT INSTRUCTIONS

Warm up unit:
Switch on regulator for positioner.
Set approx. 10 mm control-rod travel
by way of current setting and block
with control-rod-travel measuring
device. Do not switch off regulator.
Switch on test bench, set inlet
pressure as per test-specification
sheet. Pay attention to direction of
rotation and warm up unit at
n = 600 min-1. At the same time, warm
up calibrating oil to inlet temperature
as specified by test-specification
sheet. Then release control-rod
blocking mechanism, set 0 A current and
shut down fuel-injection pump.

Continue: F18/2

TEST AND ADJUSTMENT INSTRUCTIONS

Set control-rod-travel measuring
device and check shutoff position:
* Specify maximum control-rod travel
  (start position) by way of current
  setting and adjust control-rod-travel
  dial indicator to precisely 21 mm.
  This basic setting applies to all
  other tests.
* Return current to 0 A and check
  shutoff position.
  Refer to test-specification sheet for
  set value.
* Repeat procedure several times and
  check whether same result is obtained
  in each case.

Maximum permitted deviation: 0.1 mm.
Ok?

Yes: F19/2 No: F19/1

TEST AND ADJUSTMENT INSTRUCTIONS

* In the event of dissimilar results (deviations greater than 0.1 mm): Control rod or servo magnet sticking. Disassemble positioner and, where applicable, fuel-injection pump for repair.
* Incorrect shutoff position: Dimension "X" (thrust pin in servo-magnet armature) wrongly measured. Correct setting, refer to Coordinate: E13/1

Continue: F19/2

TESTING AND ADJUSTMENT INSTRUCTIONS

Checking RPS setting ("Setting" as per test specification sheet):

Set control rod by way of current adjustment such that U/act exactly corresponds to stated value. (Perform precision adjustment by hand at control rod).

The control rod travel must then likewise correspond to the value given in the test specification sheet (check value "P").

OK?

Yes: F26/1 No: F20/1

TESTING AND ADJUSTMENT INSTRUCTIONS

Setting rack position sensor:

The RPS fastening screw (clamping screw) is accessible from outside through a hole. The access hole is secured against tampering by a closure cap and sealed.

RE positioners used to feature a steel cap as closure cap; as of approx. 1992 use has been made of a plastic seal.

Continue: F20/2

TESTING AND ADJUSTMENT INSTRUCTIONS

The two different closure caps are not mutually interchangeable. Both types are therefore available as service parts.

The removal procedure for the two types is different and therefore described separately in the following:

Steel closure cap: F21/1
Plastic seal: F23/1

Continue: F21/1

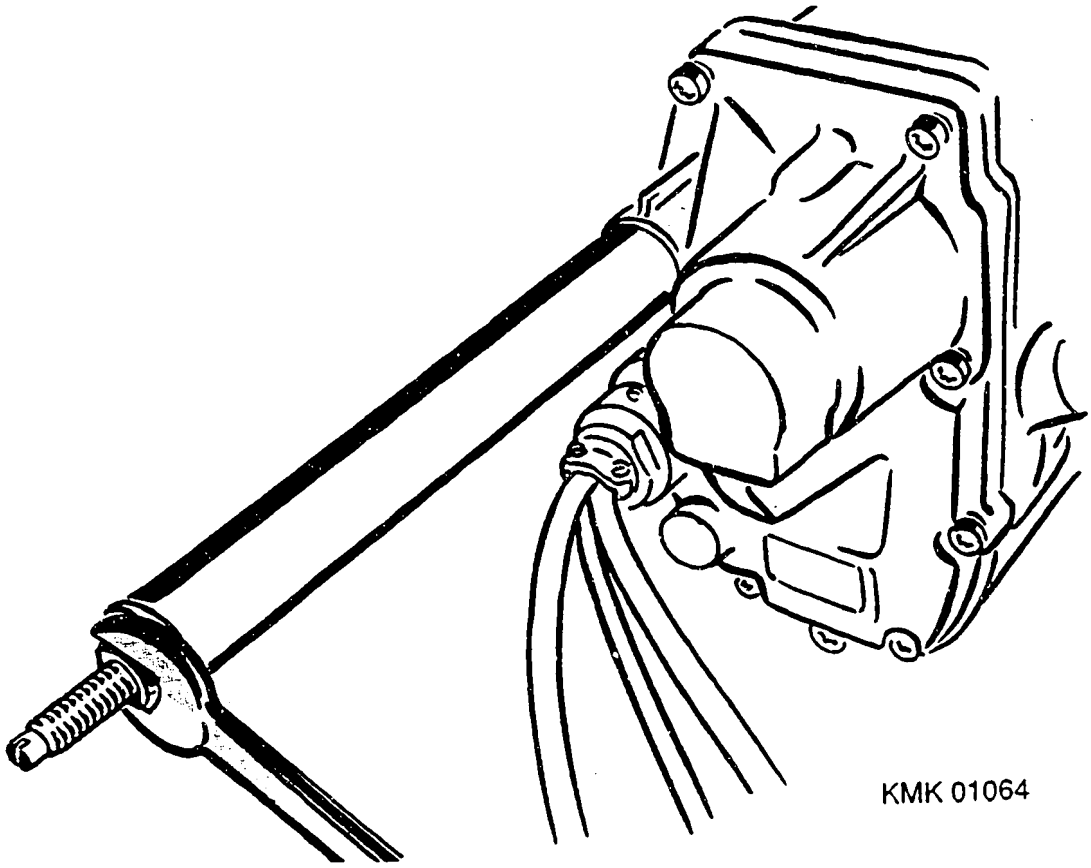
TESTING AND ADJUSTMENT INSTRUCTIONS

Removing steel closure cap for RPS adjustment bore:

Remove closure cap with spring collet 0 986 619 225 (KDAW 9995/3), threaded pin and clamping pin 0 986 619 250 (KDAW 9995/14) and corresponding support tube (user manufacture):

Loosely insert spring collet with clamping pin and threaded pin in closure cap. Tighten threaded pin and spread collet until it is firmly seated. Remove closure cap with support tube, washer and nut M 10.

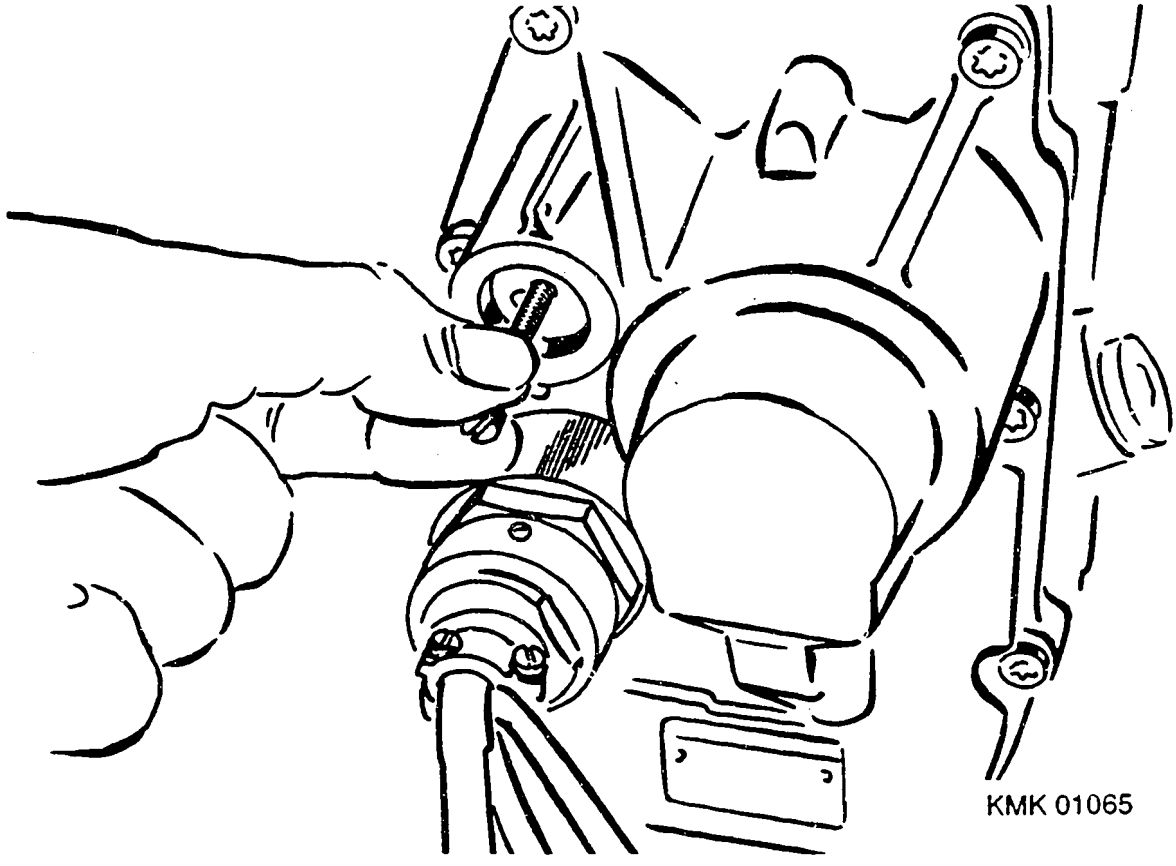
Continue: F22/1 Fig.: F21/2



Screw M 4 screw into plug and pull plug (with seal ring) out of hole.

Note: Leave screw in plug if possible, so as to ensure that plug is subsequently installed correctly (tapped hole on outside).

Continue: F23/1 Fig.: F22/2



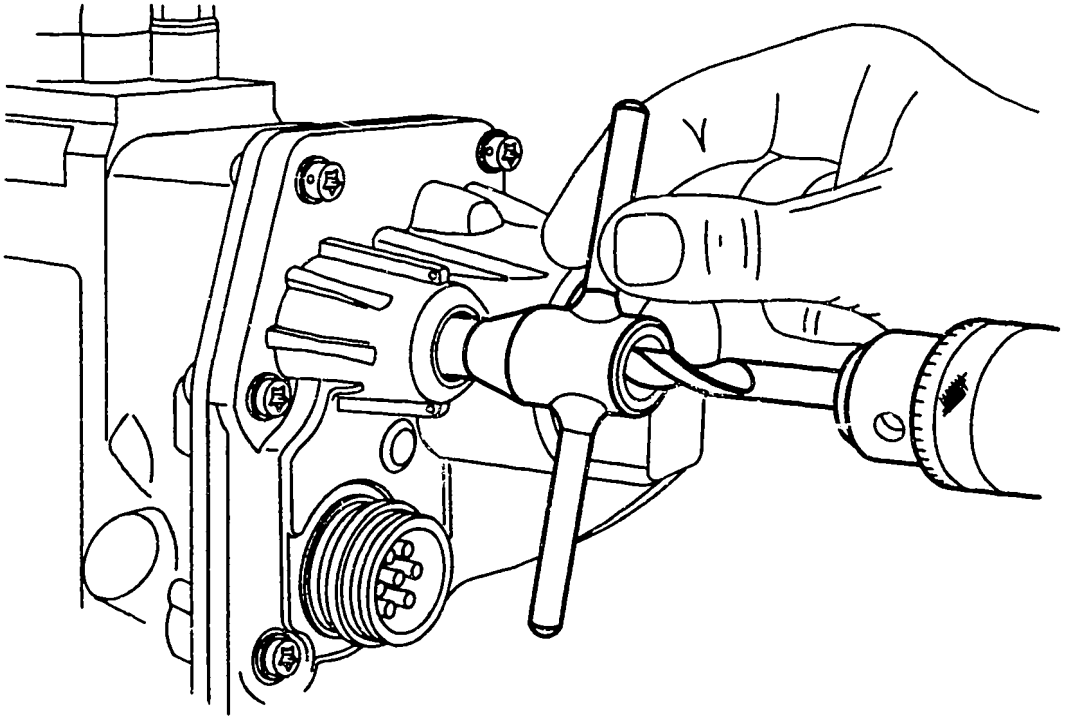
TESTING AND ADJUSTMENT INSTRUCTIONS

Removing plastic seal from RPS adjustment bore:

Seal can only be removed and destroyed by drilling it out with 12 mm drill. When doing so, hold seal with pin-type socket wrench 0 986 611 459 (KDEP 2990) to stop it turning and drill out until it is pierced (retainers break off).
Attention: Drill at low speed and do not use excessive force. After penetration, pull back drill immediately so that tip cannot catch and damage rack position sensor.

Continue: F24/1 Fig.: F23/2

KMK004480



TEST AND ADJUSTMENT INSTRUCTIONS

Adjustment procedure:

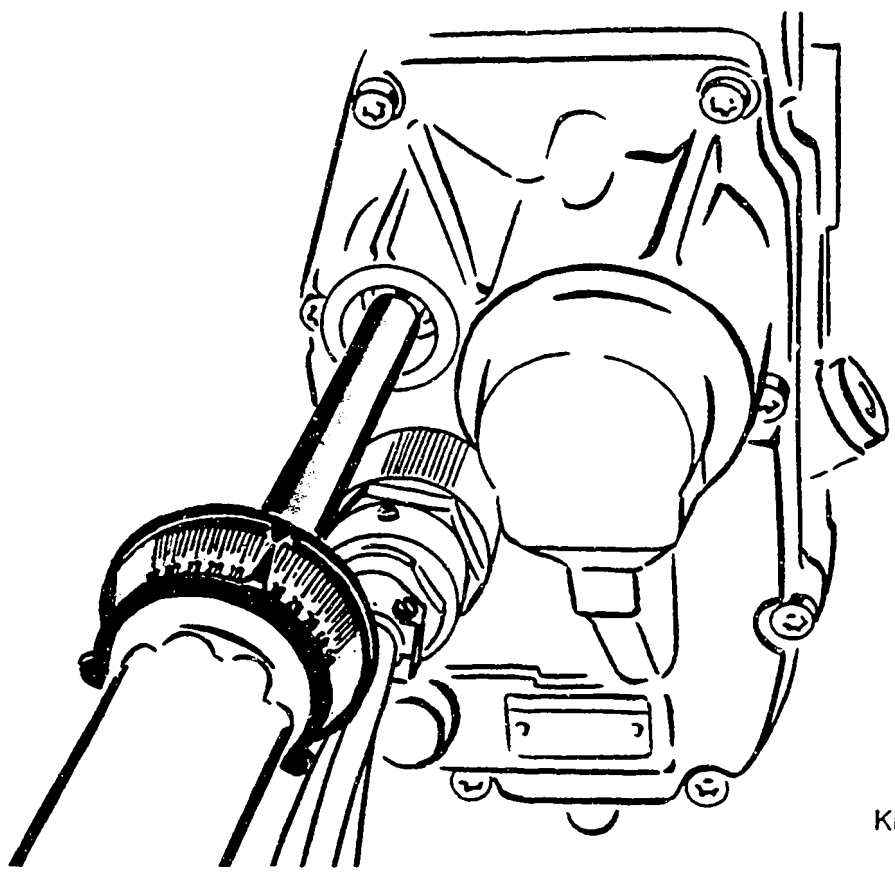
* Set control-rod travel exactly in accordance with "setting" as per test-specification sheet (mean value of tolerance range, e.g. 13.0 mm) and block at control-rod-travel measuring device.

Continue: F25/1

TESTING AND ADJUSTMENT INSTRUCTIONS

* Loosen clamping screw for RPS (5 mm hexagon socket) and move rack position sensor with Allen wrench such that U/act precisely corresponds to "setting" as per test specification sheet.
* Tighten clamping screw in this position to tightening torque of 15...18 Nm.
  Note: Tighten uniformly and smoothly, and adhere precisely to tightening torque, so as to avoid seizure of tapered clamping screw in RPS clamping sleeve.
* Check adjustment again and correct if necessary.

Continue: F26/1 Fig.: F25/2



KMK 01066

TESTING AND ADJUSTMENT INSTRUCTIONS

Checking of RPS "check value" as per test specification sheet:

Set U/act to "check value". The control rod travel must then lie within the stated tolerance band.

OK?

Yes: F27/1 No: F26/2

TEST AND ADJUSTMENT INSTRUCTIONS

If check value is outside tolerance despite correct adjustment of "setting", the rack position sensor is defective, i.e. diassembly, repair and assembly of positioner, as well as repetition of all tests.

Continue: F27/1

TESTING AND ADJUSTMENT INSTRUCTIONS

After adjusting rack position sensor, insert new anti-tamper safeguard in mounting hole.

Note: Anti-tamper safeguard with cylindrical bore: plastic seal. With stepped bore: steel cap with plug.

The plastic seal for service use is red as opposed to the factory seal which is black.

Continue: F27/2

TESTING AND ADJUSTMENT INSTRUCTIONS

Insert plug/plastic seal with new seal ring. Press in steel plug such that it is flush with housing. Press in plastic seal until retainers are heard and felt to engage.

Continue: F28/1

TEST AND ADJUSTMENT INSTRUCTIONS

Testing of speed sensor (speed signal):

Important: The test outlined in the following must be performed with extreme care. Incorrect/tolerance-exceeding speed signals result in incorrect speed evaluation in the vehicle by the control unit and thus in incorrect - in extreme cases critical - engine behavior.

Continue: F28/2

TESTING AND ADJUSTMENT INSTRUCTIONS

* Connect up two-pin lead (to 7-pin plug of universal test lead) - blue and green connectors - to oscilloscope. Pay attention to oscilloscope operating instructions. Time setting: 10 ms.

* Testing is performed with the control rod in the shutoff position (current 0 A) and at two speeds: 60 1/min and 600 1/min.

Continue: G01/1

TEST AND ADJUSTMENT INSTRUCTIONS

* The pulses shown by the oscilloscope provide information about the distance between the pulse generator and the pulse wheel, as well as information on the eccentricity of the pulse-wheel vanes.

* Refer to following Coordinates for evaluation of speed pulses.

Continue: G02/1

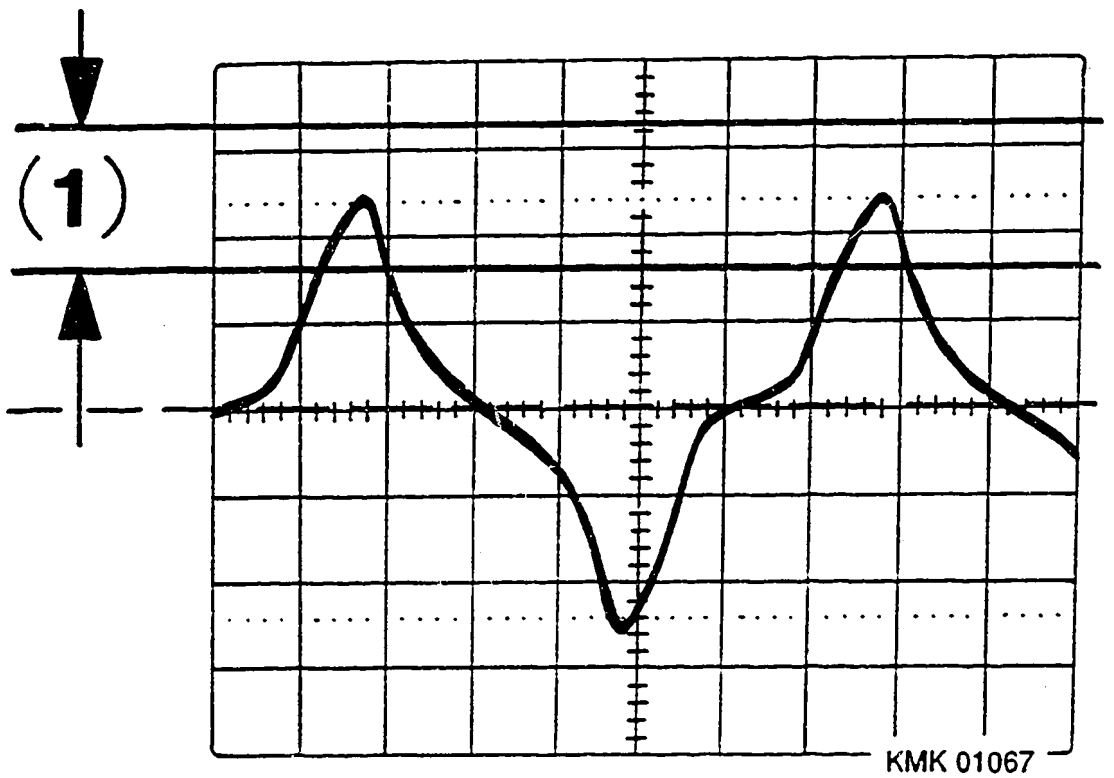
TEST AND ADJUSTMENT INSTRUCTIONS

Testing at speed n = ó0 min-1:

The magnitude of the individual pulse is tested. The positive voltage amplitude must be in the tolerance range as indicated in the test-specification sheet (number (1) in picture example).

Ok?

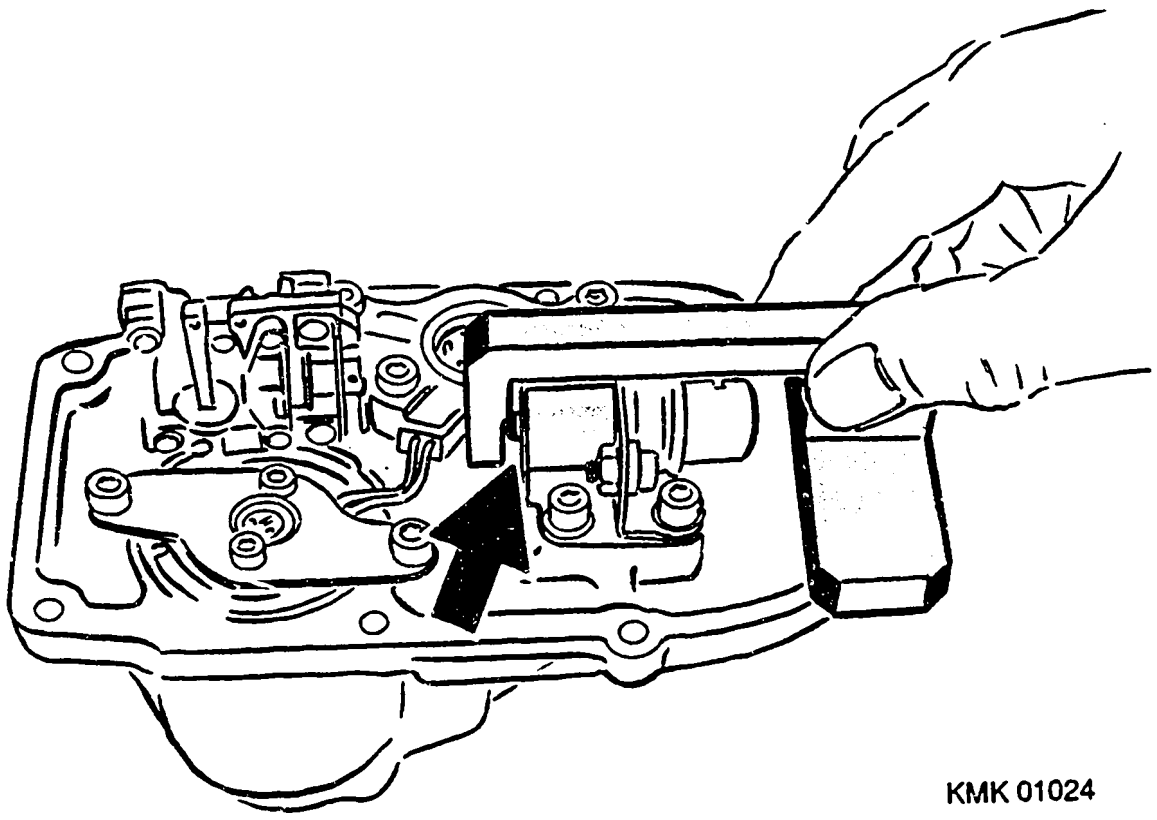
Yes: G06/1 No: G03/1 Fig.: G02/2



TESTING AND ADJUSTMENT INSTRUCTIONS

Cause of problem if value is incorrect:
Wrong distance between pulse generator and pulse wheel. Remove positioner cover to correct:
Screw out two screws and screw in guide pin 0 986 612 598. Remove remaining screws and take off cover via guide pins. Screw adjustment gauge 0 986 612 301 (KDEP 1701) to positioning pin of positioner cover. Loosen the three fastening screws and move pulse generator until it makes contact with measurement surface of gauge. Tighten fastening screws to tightening torque of 9...11 Nm.

Continue: G04/1 Fig.: G03/2



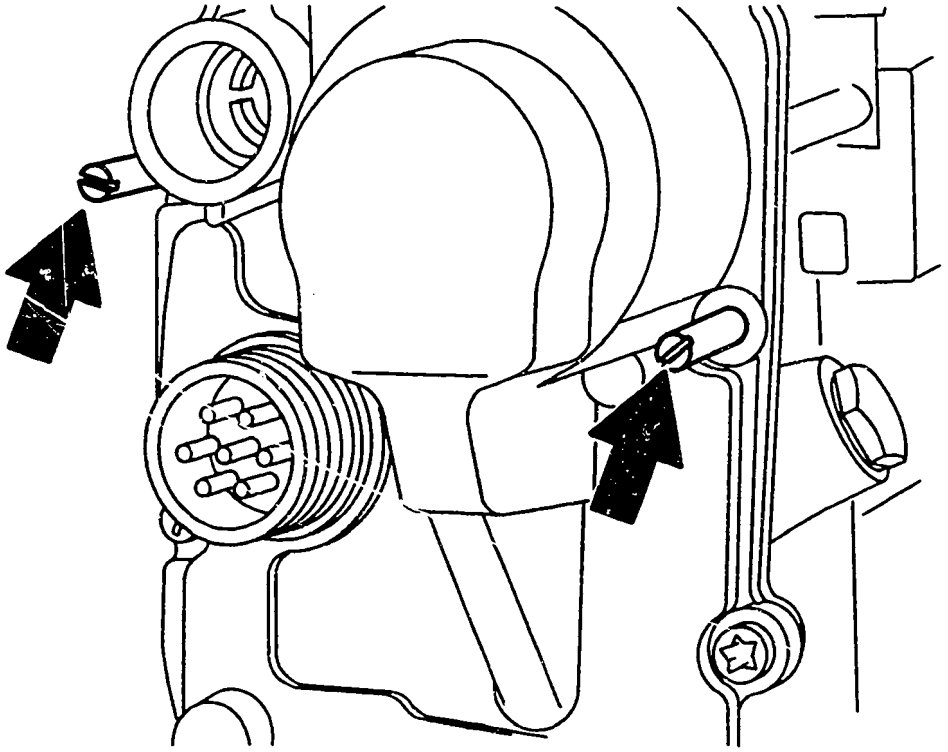
KMK 01024

TESTING AND ADJUSTMENT INSTRUCTIONS

Carefully fit positioner cover with the aid of the guide pin 0 986 612 598 (screw guide pin into fastening holes for positioner cover roughly on a level with magnet). In doing so, take care not to damage RPS measurement arm, shorting ring and pulse generator.

Continue: G05/1 Fig.: G04/2

KMK04486



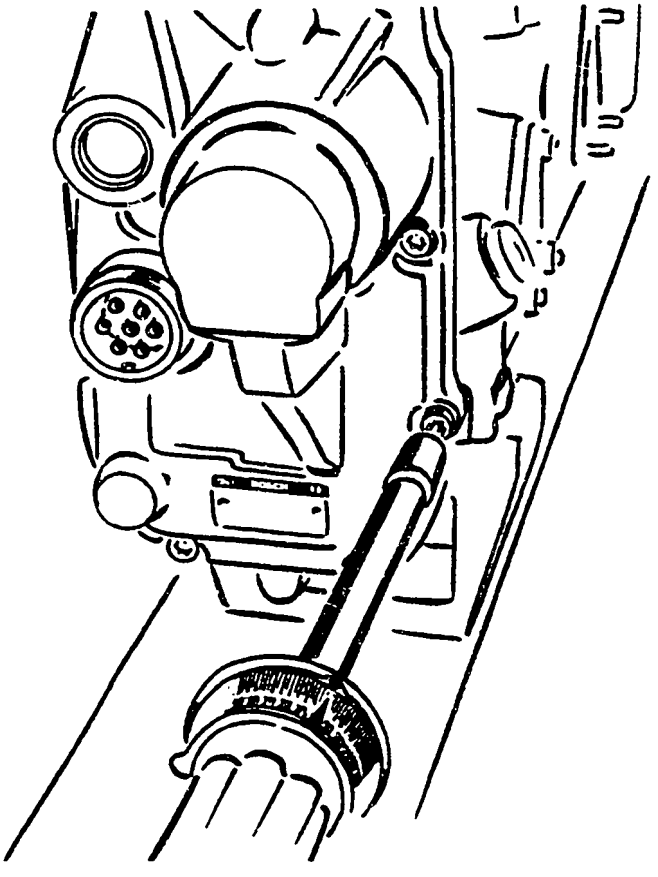
TESTING AND ADJUSTMENT INSTRUCTIONS

Press on cover, screw in screws with lock washers and tighten to tightening torque of 7...9 Nm.

Recheck correct setting at speed n = 60 1/min.

Note: After reinstalling positioner cover always check setting of rack position sensor as a final step.
See coordinate: F19/2

Continue: G06/1 Fig.: G05/2



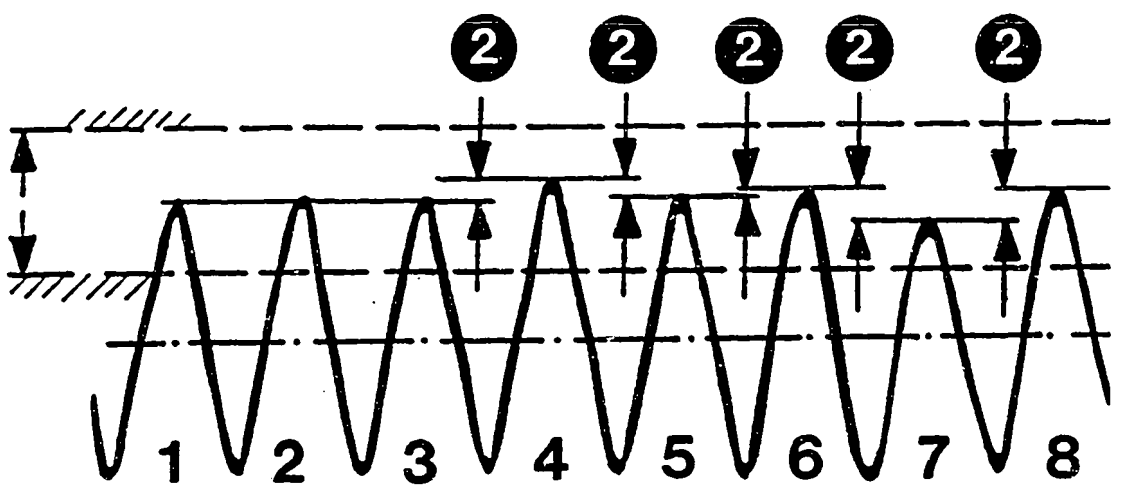
KMK 01056

TEST AND ADJUSTMENT INSTRUCTIONS

Testing at speed n = 600 min-1:

A check is made on the uniformity of signals for one revolution. The number of signals corresponds to twice the number of fuel-injection-pump barrels (picture example: 4-barrel pump = 8 pulses).
Note: Voltage value roughly corresponds to 10x vis a vis the value at n = 60 min-1.
The differences between two consecutive voltage amplitudes in each case may not exceed the value given in the test-specification sheet (numbers (2) in picture example).
Ok?

Yes: G08/1 No: G07/1 Fig.: G06/2



KMK 01068

TEST AND ADJUSTMENT INSTRUCTIONS

Difference values too large: Replace pulse wheel. Refer to Sections "positioner disassembly" and "positioner assembly".

Important: The "old" pulse wheel is not to be dressed (danger of fracture).

After re-assembling positioner cover, repeat check on rack-position-sensor adjustment and speed signals.

Continue: G08/1

TESTING AND ADJUSTMENT INSTRUCTIONS

Checking and adjusting delivery:

* Affects test items V1 and L1 as per test specification sheet.

  U/act value is set by adjusting current. Precision adjustment is effected by hand by moving the control rod. Precise U/act value is fixed by blocking control rod at CRT measuring device.

Continue: G08/2

TESTING AND ADJUSTMENT INSTRUCTIONS

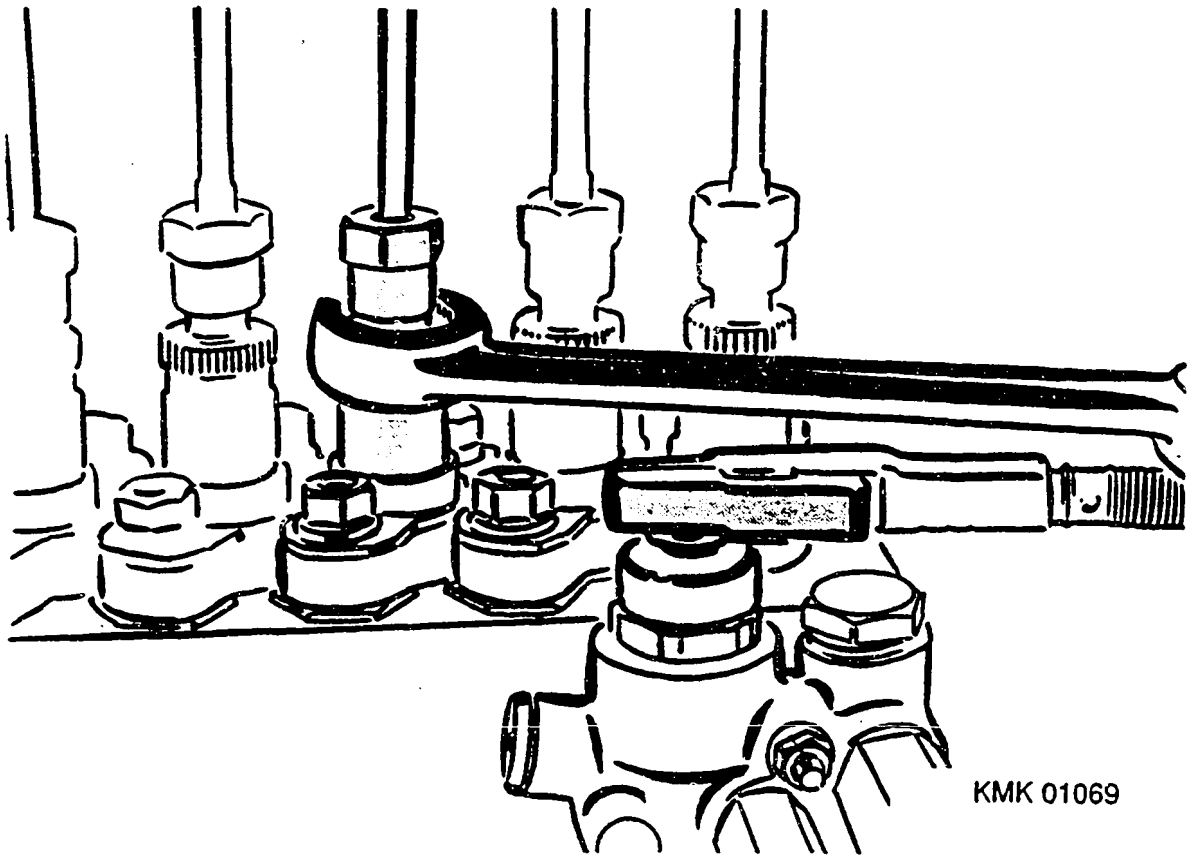
* Basic adjustment as per test item V1: Run pump at speed indicated. By way of current adjustment and precision adjustment by hand, set exact U/act value for V1 and block.
* Measure injected quantity. Values must coincide with test specification sheet.
  Note: Determination of mean value and scatter as for pumps with mechancial governors. Check values are marked "P"; values with no "P" apply to new settings.
* Are injected-quantity values OK?

Yes: G10/1 No: G09/1

Set average value and uniform delivery in accordance with test item V1.

Delivery correction as for mechanically governed fuel-injection pumps.

Continue: G10/1 Fig.: G09/2



KMK 01069

TESTING AND ADJUSTMENT INSTRUCTIONS

Then implement test item L 1.
The main test criterion for L 1 is the injected-quantity value as stipulated in the test specification sheet. This value must be within the stated U/act tolerance band.
Procedure: Set position of control rod such that L 1 injected-quantity value as per test specification sheet is obtained. This means that the correct value is to be "sought" where necessary by taking several injected-quantity measurements. The U/act value must then lie within the tolerances stipulated in the test specification sheet.
Are all L 1 tolerance values attained?

Yes: G11/1 No: G10/2

TESTING AND ADJUSTMENT INSTRUCTIONS

Possible causes of trouble:

* U/act not within tolerance despite correct injected-quantity value:
  + Rack position sensor defective.
  + Fuel-injection pump worn; possibly wrong barrels.

* Excessive scatter:
  + Scatter can be optimized with L 1, but this must not result in tolerances being exceeded with V 1.
  + Fuel-injection pump worn.

Continue: G11/1

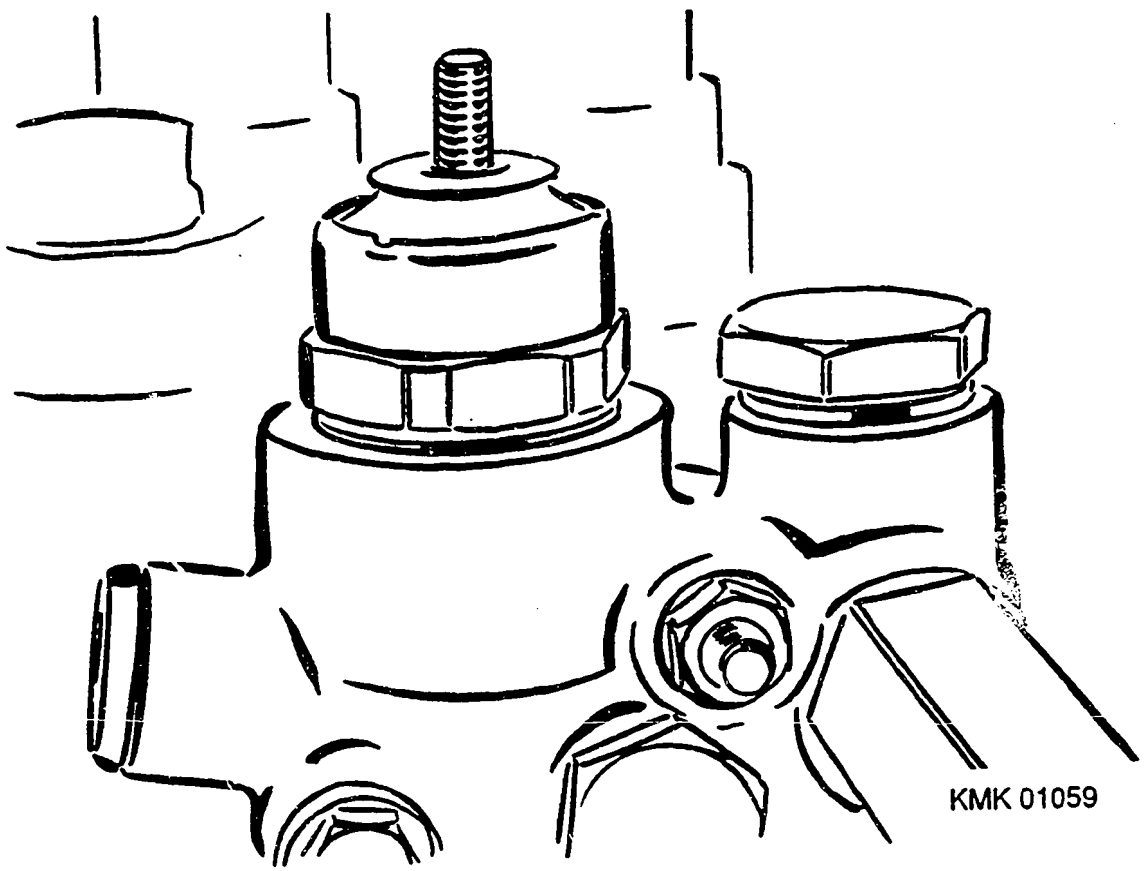
TESTING AND ADJUSTMENT INSTRUCTIONS

ELAB functional test:

* Power supply connected up to ELAB.
* Set speed to: 1000 1/min
* Set U/act to: 3.1 V
* Disconnect power supply at ELAB, observe quantity conveyed to calibrating nozzle-holder assembly.
  After test period: 10 sec.
  Delivery must be: zero

Is zero delivery attained after test period?

Yes: G13/1 No: G12/1 Fig.: G11/2



TEST AND ADJUSTMENT INSTRUCTIONS

If zero delivery is not attained after test period: Replace ELAB.

Secure new ELAB in position in ELAB housing using tightening torque of 50...60 Nm.

Repeat functional test.

Continue: G13/1

TEST AND ADJUSTMENT INSTRUCTIONS

Functional testing of oil pump:

Test prerequisite: Positioner sealed, rack-position-sensor adjustment hole sealed, control rod in shutoff position (current 0 A).

Test with suitable vacuum gauge (e.g. Bosch vacuum gauge 1 688 130 032 - special accessory for injection-pump test benches - or commercially available) with hose and rubber plug suitable for start-of-delivery bore.

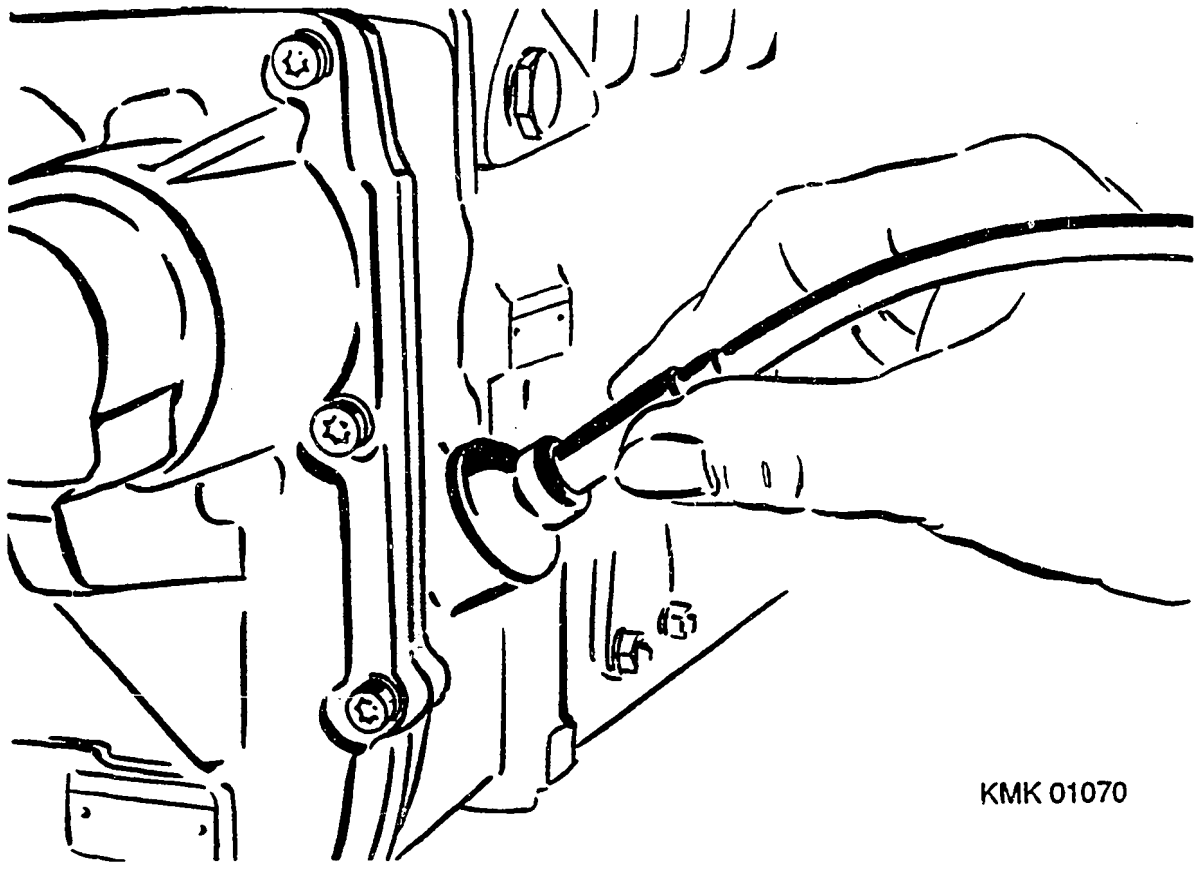
Continue: G14/1

TEST AND ADJUSTMENT INSTRUCTIONS

Test procedure:
* Pour oil SAE 20 W 20 into positioner by way of start-of-delivery bore on side until it overflows (adjusting flange), however max. 100 cm3 (with no adjusting flange).
  Operate pump at n = 1000 min-1 and immediately connect rubber plug with hose to start-of-delivery bore (press on tightly). Determine vacuum value after measurement period of 30 seconds.
  Set value: min. 25 mbar.

Is set value attained?

Yes: G16/1 No: G15/1 Fig.: G14/2



KMK 01070

TEST AND ADJUSTMENT INSTRUCTIONS

Possible causes of trouble in the event of inadequate oil pump performance:

* Positioner leakage. Eliminate leak.

* Oil pump defective. Replace oil pump. To do so, refer to Sections "Positioner disassembly" and "Positioner assembly".

Following re-assembly of positioner cover, repeat check on rack-position-sensor adjustment and speed signals.

Continue: G16/1

TEST AND ADJUSTMENT INSTRUCTIONS

Testing of fuel temperature sensor (if provided) in ELAB housing:

Test prerequisite: Calibrating-oil temperature 38...42 degrees C.

Resistance measurement at both pins of temperature sensor.

Set value: 0.95...1.4 kohms.

Replace defective fuel temperature sensor and tighten to tightening torque of 30...35 Nm.

Continue: G16/2

TEST AND ADJUSTMENT INSTRUCTIONS

Concluding operations:

Remove unit from test bench and completely assemble for delivery:

* Fit supply pump with new seal, completely assemble original drive coupling, screw on end cover for delivery-valve holders (where envisaged for pump concerned) and screw on control-rod closing cap on pump drive end.

Continue: G17/1

TESTING AND ADJUSTMENT INSTRUCTIONS

* Attaching all seals to pump and positioner:

  Pump: at top end cover (if provided with pump version concerned).
  Positioner: depending on positioner version, wire seals for the two upper cover fastening screws and RPS steel closure cap/plastic seals as per service parts list. Location as far as possible same as on delivery.

Continue: G17/2

TEST AND ADJUSTMENT INSTRUCTIONS

Pour oil SAE 20 W 20 into positioner by way of the start-of-delivery bore on the side until it overflows (however at the most 100 cm3) and screw in screw plug.

Continue: N27/1

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Continue: N27/2

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